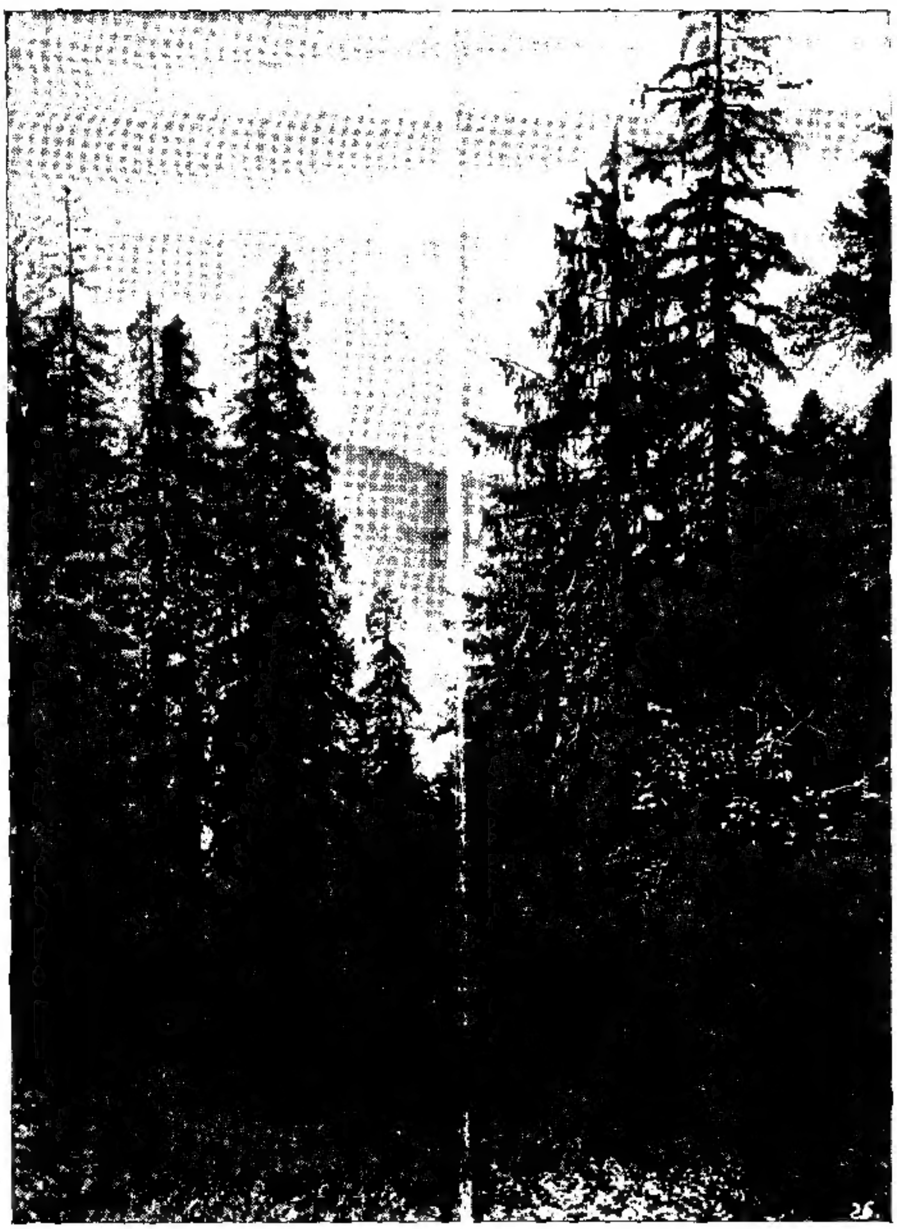

[illegible] Deodar Growth in the Himalayas.

Photo-Mechl. Dept., Thomason College, Roorkee. Photo. by E. C. M[illegible]

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FOREST MUSEUMS.

I.—THE FORMATION OF PROVINCIAL OR CIRCLE MUSEUMS.

Perhaps no word in our language brings to the mind such a totally different series of objects or gives rise to such varied memories as the word Museum, and, unfortunately, very often the collections are of such a mixed nature and arranged with so little attention to any form of systematic classification or the position occupied by the articles exhibited, either in the world of nature or art or in man's own estimation, that a visit to a Museum not unusually results in a feeling of depression and weariness. That this is exactly the converse of what should be the case, or what can be made to be the case, is well known to those who have been in a position to understand how a large Museum is arranged and worked, when it is in the happy condition of having both funds and space available. It may be pointed out at once that any niggardliness in the latter has a great and lasting effect on the general welfare, beauty and economic uses of the Museum; for both suffer to a much greater extent than the uninitiated would imagine

Parsimony in money aid is, of course, that which robs so many Museums of three-fourths of their usefulness; and we do not here mean that the money aid is required for the purchase of collections or individual specimens. Money is quite as necessary for the internal fittings of the rooms, in order to ensure that the objects exhibited are shown in a manner which, whilst being effective, will at the same time strike home to the mind of the visitor with sufficient force to ensure that the impression he receives through his visit is the one sought to be given and the one, perchance, which he came in search of.

To the professionally trained Forest Officer and, in fact, to all educated men, it is unnecessary to discourse upon the usefulness and educational advantages afforded to the State by Museums. That the creation of such with this object in view invariably follows close upon the appearance of a new State in the world is well known. This being so, it follows that a Museum can be made equally useful, and is, indeed, equally necessary, to any particular branch of trade to any particular branch of art or to any specialised branch of science. *We need not stay here to* point out that this is now becoming fully recognised and that innumerable special collections exist in the world, each having one single object in view, *i.e.*, the education of the particular class or collection of human beings whom that trade or art or science most nearly affects in their daily life and work.

Confining ourselves to science we know that to whatever branch we may turn, we shall find that the tuition of the student is supplemented and assisted by the practical exhibition of the subjects dealt with, wherever this proves feasible. Perhaps there are few professional educations in which the Museum is so necessary an adjunct as in the case of the preparation of students for the professional charge of large forest tracts. The Forest Officer has been called a Jack-of-all-trades, the allusion being rather to the great variety of subjects he has to assimilate during his education than to a variety in the nature of his work, although this in itself is diversified enough. Not one Museum is necessary for the adequate training of the student but many, and in a properly

equipped Forestry College these will be found each in its proper place and sharply marked off the one from the other. Museums of this nature, beautifully arranged, may be seen at the Forest Institutions in Germany, Munich, Eberswalde, Aschaffenburg, &c.), at St. Petersburg, Nancy, and elsewhere. At Dehra there are the beginnings of what should prove eventually a Museum unique, both for its variety and usefulness, in the world. Want of space has up to date hampered it. This Museum will however be, we should say, is intended to be, an Indian one, *i.e.*, it aspires to gather together collections of forest utility from the whole of the area managed by the Indian Forest Service. That one such institution is required for the Department and country as a whole is of course an unrefutable fact, and Dehra is naturally the position *par excellence* for it. But whilst such a Museum is desirable, we are of opinion that its value would be greatly intensified were it supplemented by provincial forest Museums. This idea is no new one. What may be almost termed such exist in Germany. A departure on these lines has been made in Saxony. Each Conservator has in his office a box of mounted specimens of each of the chief insect pests he has to fear in his forest, accompanied by a note describing the danger and damage to be feared from and the immediate steps to be taken for dealing with, or preventing, sudden invasions. In India the thing has been attempted in a desultory fashion at times. Mr. A. E. Wild, when Conservator of Forests in Bengal, commenced a collection in Darjeeling, but we believe nothing definite or lasting has resulted. To Mr. Gass Conservator of Forests, Coimbatore, Madras, the honour falls of making the first real departure in this respect. Some four years ago this officer conceived the idea of starting a collection of specimens of timber and other forest produce and set apart one of the rooms of the Conservator's office for this purpose. At that time it was intended that the collections should be limited to the Southern Circle, and, with the approval of the Board of Revenue, a Circular was issued to all Forest Officers in the Circle explaining the object and scope of the proposed institution and communicating the heads under which specimens were required. Specimens began to arrive in February 1902, and

the numbers increased so rapidly that it soon became evident that a most interesting and instructive Forest Museum could be formed if its scope were extended to the three circles of the Presidency. This has since been done and the usefulness and value of the Institution has become so evident that His Excellency the Governor, Lord Ampthill, who was himself the first to sign the visitor's book, has sanctioned the erection of a special building for housing the exhibits on up-to-date lines. We propose dealing with the contents and arrangement of the Coimbatore Forest Museum, or to give it the name which has recently received official sanction, the Gass Forest Museum, in a subsequent article, but we would here heartily congratulate its originator both on its inception and upon the lines upon which it has been worked up, it having been our privilege to inspect the collections in 1902.

It is the purpose of this article to point out the great advantages accruing from the formation of such provincial Museums and to suggest the desirability of their creation in all the other provinces of the Indian Empire. In the cases where there is but one Circle in a province the Museum should be at the head-quarters of the Conservator. Where there is more than one Circle, the Museum would naturally be situated at that Circle's head-quarters which is at the same time most accessible and most advantageous climatically for the preservation of the exhibits. Such Museums would be a valuable acquisition to a province, since it would be possible for officers to visit them and so make themselves practically acquainted with the more valuable timbers, with the appearance and nature of valuable minor products, with the appearance of the different soils, rocks, &c., with the botanical appearance of the chief trees and their seeds, fruits, &c. : in fact, with the importance, economic and scientific, of the products of their forests as well as with the various pests ; all of which information can at present be only learnt by slow degrees and, even then, very imperfectly.

In advocating the formation of such Museums, and we would wish to point out to Local Administrations the extreme value of such from every point of view, we would strongly deprecate any

attempt to go beyond the strict province and limits for which they are formed. Any thing like specialisation in any line or department or attempts to procure rare or unique specimens should be most strongly discountenanced. The Museum should also be strictly confined to the Province to which it appertains and whose Government pays for its upkeep. This tendency to specialisation is the danger, the grave danger, which faces and tempts all Museums which are of purely local interest and whose upkeep was, in the first instance, sanctioned with this sole idea in view. We read that amongst the collections in the Gass Museum there is an extremely rare badger skin. Further 'the collection of snakes is also small at present, but such specimens as there are appear to be uncommon.' The Madras Government pay a considerable sum of money annually for the unkeep of a Central Museum at Madras in which the 'rare badger skin' would find a much more fitting, and probably a safer, resting place than in the Forest Museum at Coimbatore. Again, what real good can be attained by collecting together, in a Museum essentially kept up for the *practical* instruction of Forest Officers, a number of snakes most of which are *uncommon*. The Forest Officer interested *practically* in snakes would not visit the Coimbatore Museum to study the uncommon ones found in the Madras Presidency ; his object would be to study the common ones likely to be met with in his daily journeys in the forest, both poisonous and non-poisonous, and we think that this one illustration will serve to point our moral, and contains in a nutshell the whole crux of our advocacy of the Circle Forest Museums. The sole aim and object of such should be their *practical usefulness* to the forester in his every day life and work. The Conservator, under whose charge the Museum would be, is not a Museum specialist. To attempt to be such will and must result in one inevitable ending, the decadence and ruin of the Museum. If rare specimens are sent in to him by Forest Officers, as they will be sent in, let them by all means be entered in the Museum register, since this register will for all time show the value of the scientific work which the Museum has been a participator in, but let the entry be followed by the despatch of the specimens to the Museum kept up by the State for

this purpose. The Forest Museum we advocate, and the possibility of whose formation has been so adequately demonstrated by Mr. Gass, is one for the practical Forest Officer, and the greatest care should be taken to keep it free from the specialisation of the Museum proper.

Further, it should be confined entirely to the area comprised in the Circle, or the series of Circles, for the instruction of whose officers it has been formed. We have already pointed out that the General Indian Forest Museum is in process of formation at Dehra, and it will be a simple matter for Conservators to depute promising officers to supplement their study of the local provincial Museum by a further period at Dehra Dun, in cases where they are of opinion that such study will be of advantage to their Governments.

SCIENTIFIC PAPERS.

EUGENIA PRÆTERMISSA—A HITHERTO UNDESCRIBED SPECIES FROM ASSAM AND BURMA.

BY A. T. GAGE.

In the course of a botanical excursion made by the writer in 1899 to the South Lushai Hills, which fill up the southern apex of Assam, a species of Eugenia in fruit was found in fair abundance in the neighbourhood of Fort Lungleh at altitudes of 1,000—3,000 feet. The fruit is appreciated for its edible qualities by the Lushais, who at the time of the writer's visit were to be seen collecting it in characteristically careless fashion by cutting down large branches to allow of the fruit being picked at leisure. The writer was informed that the Lushais made a sort of jam of the fruit. In 1899 the species was not identified with any in the Calcutta Herbarium, but in 1902, when the writer had occasion to incorporate in the Herbarium the Malayan species of Eugenia which had been elaborated by Sir George King, he discovered examples of the same species in flower, which had been collected in

A.N. Banerji del. S. C. Mondul lith.

EUGENIA PRAETERMISSA Gage.

Assam by Griffith and by Mann and in Burma by Prazer. Materials for a description of the species being thus available, the writer prepared a description of the species in 1902, which—hitherto unpublished,—is given below. The writer is indebted to Sir George King for having kindly compared the species with the collection of Eugenias at Kew.

Eugenia prætermissa.—A tree 12—16m. high. Young branches as thick as a crow-quill terete, pale brown, glabrous. Leaves coriaceous, opposite, glabrous above and below, lanceolate or ovate-lanceolate, acute or acuminate, base cuneate, shortly petioled, upper surface of lamina shining dark olivaceous, under surface rusty brown; main nerves very numerous, somewhat faint, running closely parallel and somewhat forward to end in the intra-marginal vein; length of lamina 6·5—10·6 cm., breadth 2·5—4·3 cm.; length of petiole 1·2 cm. Flowers in axillary cymes as long as the leaves or half as long. Peduncles 1·2 cm. long, usually bearing two to three flowers. Flowers 6·5—8 mm. in diameter; calyx tube 6·5 mm. long, widely campanulate, passing into a very short pseudo-stalk, epedicellate lobes four, broadly triangular, slightly inflexed; petals suborbicular, white, dotted. Stamens 8·4 mm. long. Fruit about the size of a small cherry, 1·2 cm. long, 8 mm. in diameter, oval, smooth dark red, black when dry, crowned with the calyx.

Assam—*Griffith!* Khasia Hills—*Griffith! Mann!* Kendat in Upper Burma—*Prazer!* S. Lushai Hills, Assam—*Gage!*

This species has been confused with *Eugenia Griffithii*, Duthie, from which, however, it is distinguished by its oval fruit and smaller much less coriaceous leaves. Its nearest affinity is with *Eugenia chlorantha* Duthie.

DESCRIPTION OF PLATE.

Fig. 1, flowering branch; Fig. 2, fruiting branch; Fig. 3 longitudinal section of bud; Fig. 4, opened flower; Fig. 5, longitudinal section of mature flower, calyx and corolla not shown; Fig. 6, fruit, with half of pericarp cut away. Figs. 1 and 2, *natural size*. Figs. 3—6, slightly magnified.

ORIGINAL ARTICLES.

THE DISTRIBUTION OF THE FOREST FLORA OF THE BOMBAY PRESIDENCY AND SIND.

BY W. A. TALBOT, CONSERVATOR OF FORESTS, BOMBAY.

The Bombay Presidency including Sind extends from 28° 47 and 13° 53′ north latitude and from 66° 43′ to 76° 30′ east longitude, and contains an area of nearly 196,000 square miles.

Generally the forests, scrub and bush woodlands of this territory form a belt of vegetation about 500 miles long and 50 miles broad, nearly parallel with the Western Peninsular coast line, from 200 miles north of Bombay to the Mysore frontier in the south. The wooded areas extend over the hills and valleys of the great mountain chain of the Sahyadris, usually called the Western Ghats. These run from the Tapti river to the Bhatkal sub-division of North Kanara, and traverse the Bombay Presidency from north to south in a more or less continuous chain. This wide zone of mountainous country may be considered as a series of plateaux which have escaped denudation. In its northern half and as far south as Malwan in the Ratnagiri district, almost horizontal layers of trap, cut into steep scarp by denudation constitute the geological formation. The escarpment parallel with the coast line resembles a line of sea cliffs and is strongly suggestive of marine origin, which theory is strengthened by other evidence. The highest summits of the ghats about 4,500 feet high (one or two peaks in the Nasik district slightly exceed this height) are usually flat topped and are strong evidence of the remains of an ancient elevated plain. Geologists hold that the Western Peninsula has not been submerged since archaic times. The conformation of the continental land areas in pretertiary ages was quite distinct from what it is now. There is no evidence of ice action south of the Himalaya or other great changes in temperature later than the post tertiary epoch. The scanty vegetation of the dry trap region consists of long grasses, deciduous, often thorny bushes and widely scattered

stunted trees. During the dry season this area presents a desolate desert like aspect, which contrasts with the bright green of the vegetation during the rains.

South of Malwan on the 16th degree of north latitude the igneous rock disappears and metamorphic schists with intrusive crystalline gneiss and granite are the principal constituents of the range. The soil from these formations is often deep and fertile and on the humid well drained slopes of the southern ghats, both the evergreen tropical and deciduous high timber forests attain great perfection. High level laterite caps many of the Western Ghat hills. A similar rock sometimes called low level laterite, usually of detrital origin, covers large areas of the low-lying country from the coast inland. The vegetation on the hard ferruginous clay soil or bare laterite itself of the region with a heavy rainfall is characteristic. There are two geological formations further inland under a very diminished rainfall and of minor importance from a forest point of view, the first or Dharwar system consisting of crystalline schists, conglomerates and quartzites. The dry barren Kuput hills in the Dharwar district and the country round the town of Dharwar itself belong to this system. The trees and shrubs of most of this region are small and stunted; only a restricted number of species can resist the periodic seasons of drought. The flora is therefore poor and semi desert in character. On the southern border of the Deccan trap area about the latitude of Vengorla we find a second system; a series of hard crystalline rocks, cherty breccias, sandstones, limestones and schists, known as the Kaladgi series which occupies most of the forest area of Bijapur. In the dry eastern part of the Belgaum district small tree forests with a characteristic flora are situated on this formation. The tree vegetation along the banks of the Indus and Tapti river grows on the recent and sub-recent alluvium carried down by these great streams.

The mass of the forests lies on the slopes of the ghats and between the chain of hills and the sea. The south west monsoon rainfall which is the principal climatic factor affecting the type of vegetation reaches a maximum on the tops of the highest hills and

diminishes rapidly in intensity towards the north and east. This forest zone, influenced by the diminishing humidity of the climate, comes abruptly to an end towards the east about 50 miles from the sea. The hill ranges in Mysore, far from the sea coast, attract a varying rainfall which grows in intensity from the lower to the higher elevation, the Bababuden hills for example. Below 25 inches annual rainfall, the Western Peninsular tree vegetation scarcely merits the name of forest, and in the Sholapur, Bijapur and eastern parts of the Belgaum, Dharwar, Deccan and Konkan districts the woodlands degenerate into small scrub jungles. Further east these jungles give place in favourable situations to small trees and shrubs which, however, do not group together into forest, in the strict sense of the word. Owing to the continuous seven months' drought of the dry season, when for a considerable period the mean daily temperature exceeds 100° F., differences of several inches in the annual rainfall do not materially influence the type of the vegetation. It is only when the fall reaches 70 inches that a distinct change in the flora is observed.

In the Bombay Presidency the highest peaks of the Sahyadris do not exceed 4,500 feet; a few points attaining that altitude near Mahableshwar in the Satara District. In the Nasik Collectorate away towards the east are one or two isolated peaks about 5,000 feet in height. The comparatively high altitude of these latter hills does not apparently affect their flora. The mean general height of the great Indian plateau to the east of the main axis of the ghats is about 1,800 feet above the sea level. The vegetation is therefore tropical in the areas under consideration. Very few species of the sub tropical Nilgiri "Shola" type are found within the Presidency limits. Further south in the Bababuden hills of Mysore at a distance of about 90 miles from the sea the Nilgiri Shola forest makes its first appearance, between 4,500 and 6,000 feet elevation. However in the north with the exception of one or two species of Rubus, Rhamnus Wightii, Crotalaria Leschenaultii, two species of Carex, and possibly two or three other species of the southern "Shola" type, the vegetation of the entire Bombay Presidency is strictly tropical.

The term "Forest Flora" applies in this article to the indigenous ligneus vegetation covering the areas under consideration. Incidentally reference will be made to the herbaceous undergrowth and epiphytic flora. Descriptions of the indigenous ligneus species found in the forests of the Bombay Presidency and Sind are contained in my "Trees, Shrubs and Woody Climbers" published in 1902. Hitherto several sketches of the distribution of the various floras of the Indian Empire have been attempted. S. Kurz, Curator of the Herbarium Royal Botanic Gardens, Calcutta, published in the introduction to the "Forest Flora of British Burma" an account of the distribution of the forests of that Province. As this work appeared in 1877 the great regions of Upper Burma had not been added to the Empire and only the forests of Lower Burma were considered. Sir D. Brandis (late Inspector General of Indian Forests) contributed an excellent account of the general distribution of the forests in India to Ocean Highways (an ephemeral publication which appeared in 1870 or thereabouts). Mr. Gamble in the introduction to his "Manual of Indian Timbers" divides India into eight forest regions, designated by letters for convenience of reference. The distribution of different floras is not considered in detail. Of the general sketches of the Indian Empire flora the latest is by Sir Joseph D. Hooker and is included in the descriptive volume of the Indian Empire Gazetteer. The Bombay Presidency proper is here included in and forms the greater part of the 5th and 6th Indian Botanical Provinces or the Malabar and Deccan respectively. These provinces correspond in part with the areas of comparative dryness and humidity the "India vera" and "India aquosa" of Lieut. Colonel Prain's "Plants of Bengal." Outside the Presidency proper Sir J. Hooker's Indus Plain Province includes Sind, Cutch, and Guzerat and corresponds with Prain's "India deserta." Mr. C. B. Clarke, the eminent Indian botanist, in an article in the 34th volume of the Journal of the Linnean Society of London, divides British India, considered as a sub-area of the Indo-Chinese area into 11 sub sub areas for purposes of botanical reference. As Mr. Clarke restricts his divisions to 11, these sub sub areas are sometimes necessarily

artificial: for example, all Malabar and the Konkan, as well as a large proportion of the Deccan, are included in his sub sub-area No. 3 which contains two if not three floras of different origin.

The Bombay Presidency and Sind belong to three of the nine botanical provinces into which British India has been divided by Sir J. Hooker, *viz.*:—

I.—INDUS PLAIN PROVINCE.

"India deserta" of Prain and sub sub area No. 2 of C. B. Clarke. This Province includes Sind, Cutch and Guzerat.

II.—MALABAR OR 5TH PROVINCE.

"India aquosa" of Prain and part of C. B. Clarke's sub sub-area No. 3, includes the Konkan and the N. Kanara and western parts of the various districts in the Presidency as far north as Thana.

III.—THE DECCAN OR 6TH PROVINCE.

"India vera" of Prain and western part of Clarke's sub sub-area No. 3, includes the eastern parts of the Presidency districts north of Belgaum and altogether the Bijapur and Sholapur Collectorates.

The forest flora of the Panch Mahals, Surat and Khandesh Dangs and the Mandwi sub-division of the Surat district is a mixture of two floras, the Indus plain and Deccan, but the Deccan element is preponderant. In the introduction to the "Flora Indica" of Hooker and Thomson, Khandesh is included in the 5th or Malabar Province, but this view should however be modified according to our present better knowledge of that district, which possesses nearly throughout a flora of the Deccan type. The division of the Indian botanical province into a number of great territoral sub-divisions depends principally on the general consideration of species in the herbaria described in the "Flora of British India." There is no difficulty in recognising the wide differences between the floras of the moist tropical evergreens, the dry Deccan plains and the Sind desert existing in the Bombay Presidency. An attempt at a general description of the forests of this region requires however, besides a consideration of the somewhat scanty existing herbarium material, a fairly intimate knowledge of the ligneus vegetation of the

forest-clad districts within the Presidency limits. Most of the North Kanara evergreens are difficult of access, particularly so during the rainy season, these and many of its deciduous forests having been rarely if ever visited by botanists. In this and the western parts of the two neighbouring districts of Belgaum and Dharwar there is, besides the two principal forest floras, a very distinct intermediate one which contains a number of species not found in either the very moist tropical Malabar evergreens or the drier Deccan deciduous forests. The three floras are :—

I.—MALABAR FLORA.

The great evergreen forest flora, containing many genera and some entire orders of distinct Malayan origin.

II.—INTERMEDIATE FLORA.

The intermediate or high deciduous and evergreen mixed forest flora of the Western Ghats and Konkan, containing elements of different origin and without the Malayan characteristics of the former.

III.—DECCAN FLORA.

The deciduous, small tree forest flora of the dry eastern zone, mostly of gregarious species in which the African element preponderates.

That the Malay Peninsula, Ceylon and the Western Indian Peninsula formed during tertiary times parts of the same continent seems probable from botanical evidence, and there was a struggle in the region with a considerable rainfall, between the Deccan and Malabar floras. Whether this was the case or not does not affect the fact that these two floras are as distinct in character as any two others within the Indo-Chinese area. There is also, as I have remarked, in the moist ghat region an intermediate flora of mixed Malabar and Deccan elements, the latter preponderant, along with many peculiar well differentiated species of somewhat doubtful origin. This type of forest flora will be treated more in detail under "Deciduous forests.' The forests of British Burma were classified by S. Kurz in his "Forest Flora" according to their deciduous or evergreen constituents ; he also considered in his classification their elevation above the sea level and their distance

from the sea, as well as the influence of the climatic and geological conditions and the nature of the soil on which they grew. I shall here attempt a description of the Bombay Presidency forests on a similar plan and endeavour to refer them when possible to the three floras chosen.

The ten natural orders in the Bombay forest flora with the greatest number of genera and species are in order of sequence :—

Leguminosæ	47	gen.	130	spp.
Euphorbiacea	31	"	73	"
Rubiaceæ	22	"	28	"
Acanthaceæ	15	"	45	"
Urticaceæ	15	"	36	"
Asclepiadeæ	19	"	29	"
Apocynaceæ	18	"	24	"
Rutaceæ	15	"	23	"
Meliaceæ	14	"	22	"
Palmæ	11	"	15	"

EVERGREENS.

I.—MANGROVE SWAMP FORESTS.

These grow on the muddy foreshores and along the banks of tidal rivers and creeks and are subject to the tides and action of salt water. The trees are never large or high and the "massif" is usually dense with one or two predominating species. The principal natural order in this class is the Rhizophoraceæ, Carallia being the only genus of the order absent. The peculiar development of the thick asparagus like breathing and aerating roots (pneumatophores), also the aereal roots raising the stems above the muddy soil, is remarkable. The small leathery simple, succulent leaves with thickened cuticle and the elongated club-shaped radicles of the Rhizophor's pendant fruit are also characteristic. These forests (the "India Littorea" of Prain's "Plants of Bengal") appear at intervals along the coast from North Kanara to the mouths of the Indus, where the conditions are favourable. As they are common to all tropical shores they cannot be referred to any particular type of flora, area or botanical province. The principal species besides those of the genera of Rhizophoraceæ, Rhizophora, Ceriops, Bruguiera and

Kandelia, found in these forests are Excœcaria Agallocha, Cerbera Odollam, Avicennia officinalis (a small tree or shrub, probably two distinct species), Carapa moluccensis, Lumnitzera racemosa, Heritiera littoralis, (rare). Two species of Sonneratia and the shrubs Cæsalpinia Nuga, two species of Scævola, Acanthus ilicifolius, Aegiceras majus and Hibiscus tiliaceus, are very common. Derris uliginosa and D. scandens are common swamp climbers.

Sonneratia acida, common along the foreshores of the Southern Konkan, is replaced by S. apetala, in the northern districts of Thana and Kolaba. Atriplex Stocksii, Arthrocnemum indicum, Sueda nudiflora, S. and maritima (Chenopodiaceæ), also coarse grasses, Cyperaceae and the fern Acrostichum aureum, form dense patches of vegetation on ground where the mud or ooze is somewhat consolidated. Neither of the palms Nipa fruticans, or Phœnix paludosa, characteristic of similarly situated forests, are found in the Western Peninsular esturial swamps.

The tall grass Oryza coarctata, is endemic in the Sundarbans and the delta of the Indus

II.—ESTURIAL AND RIVER BANK FORESTS.

These form a fringe of vegetation along the banks of rivers and creeks on alluvial soil, which when near the sea coast is not directly affected by the salt or saline water, being above high water mark. The moist condition of the alluvial soil along the banks of rivers, nallahs and creeks and the constant seed-dispersing agency of running water are conditions productive of a varied forest flora. This river bank vegetation contains besides a number of predominent species not found elsewhere, also many of the trees and shrubs from the contiguous jungles. Cultivation has long since destroyed, in great part, the indigenous flora along the banks of the great Indian rivers flowing east across the Peninsula. Of these the head waters of the Toongabhadra and the main branch of the Krishna flow eastwards through the Satara and Poona Districts of the Bombay Deccan. The alluvium banks of these rivers are covered with isolated narrow stretches of Babul (Acacia arabica), valuable as fuel reserves, which are usually flooded once or twice during the rainy season The principal species associated with

the Babul in these forests, are Balanites Roxburghii, Ziziphus Jujuba, Capparis aphylla and Pongamia glabra. Phyllanthus Lawii, mixed with Ficus heterophylla, are sometimes found near the water's edge, and in the sandy beds of the streams the hardy Tamarisk flourishes. South of the Tapti the rivers flowing west into the Arabian Sea have a short course and the longest does not much exceed 100 miles These rivers rise from the western slopes of the ghats, and after a rapid course interrupted by a series of high waterfalls and cascades reach the lower levels of the Konkan. The North Kanara streams, greatly swollen from June till November by the tropical monsoon rains, flow throughout their courses through mixed deciduous and evergreen forests. They sometimes broaden out, usually from 5 to 16 miles before they join the sea, into wide estuaries, and the effect of the tides is felt up stream for a considerable distance inland. In the Kalanadi, one of the principal North Kanara rivers which flows into the Indian Ocean near Karwar, the water is slightly saline as far inland as Kadra, 18 miles distant from the sea. Along the Gungawali, Tadri, Gairsoppa and other North Kanara streams the riverain vegetation is not affected so far from the mouth as in the Kalanadi, by the saline water. Some of the characteristic predominant trees in these river bank forests, affected by proximity to the sea, but not growing in the muddy mangrove swamps are Barringtonia acutangula, and B. racemosa, Trewia nudiflora, Thespesia populnea, Hibiscus tiliaceus, Calophyllum inophyllum, Heritiera littoralis, Terminalia Arjuna and Pongamia glabra (this species throughout both the Deccan and Konkan), and *Diospyros Embryopteris. Ixora coccinea*, a conspicuous flowering shrub, is also found further inland along streams and in the coast mixed evergreen and deciduous forests. Entada scandens, Canavalia obtusifolia, Abrus pulchellus, Dalbergia sympathetica, D. volubilis, Acacia pennata, A. caesia and Breweria cordata are some of the more common climbing shrubs near the coast. At some distance from the sea Eugenia hemispherica, E. zeylanica, Bassia elliptica, B. longifolia and Calophyllum Wightianum with its characteristic rough conspicuous bark, are sometimes, the last mentioned very often, predominant trees. In the beds of

the North Kanara and Konkan rivers Homonoia riparia, and H. retusa as well as Rhabdia lyciodes are common shrubs. The screw pine, Pandanus fascatus, associated often with Glochidion zeylanicum, G. tomentosum, Ficus hispida, and Glycosmis pentaphylla are gregarious above ghat species. Symplocos Beddomei, Ficus heterophylla, Grewia abutilifolia, Pajanelia Rheedii, Salacia prinoides, Clematis Gouriana, C. hedysarifolia, Lagerstrœmia flos-reginæ, Millettia racemosa, Calycopteris floribunda, two species of Agrostistachys, Cratæva religiosa, Hopea Wightiana, Acacia Suma and two species of Nauclea are amongst the more common locally abundant trees and shrubs in the North Kanara and Belgaum river bank flora. Alangium Lamarkii, Mallotus philippinensis, Trema orientalis, Streblus asper, and Ficus glomerata are common near streams on the Dharwar border of Kanara. Salix ichnostachya is very abundant in the Sirpa sub-division of North Kanara. Along the river banks close to the water's edge in the deciduous Konkan forests Phyllanthus Lawii forms dense "Tamarisk" like thickets, often bordered or accompanied by a growth of the pale green Osmunda regalis. The remarkable hepatic like Podostemaceæ cover the rocks, just above the running water, in the beds of many North Kanara and Konkan rivers.

In the South Konkan and Kanara districts are numerous streams flowing over beds of reconsolidated laterite. On the great concrete like boulders in the beds and on the banks Osmunda regaolis grows abundantly overhanging the clear water in the pools. Ixora coccinea, Strobilanthes perfoliatus and strongly scented species of Compositæ (Cyathocline, Vicoa, Blumea oxyodonta, and B. Malcolmii) are common. In damp marshy places where there is a little soil, colonies of the Aroid, Cryptocoryne Roxburghii, with long grass-like leaves and twisted spathes, are found mixed with Polygonum, Cyperaceæ and grasses. The more common trees along the banks are Calophyllum Wightianum, Hopea Wightiana, Bassia malabarica, Strychnos Nuxvomica, Holigarna Arnottiana, Ficus hispida, and clumps of Ochlandra ("Hooda") bamboo. Podostemaceæ are absent from many of these streams. Above ghats near Yellapur in the river bank flora, Hopea Wightiana is

nearly always very common, sometimes mixed with Nauclea missionis, and fine clumps of Bambusa arundinacea Pandanus (Screw pine) brakes usually occupy the muddy and marshy places and in the sandy dry beds of the streams Argemone mexicana, prostrate Compositæ, Cyperaceæ, Gramineæ, Polygoneæ and Euphorbiaceæ are found during the dry season. Many of the rivers and streams dry up during the hot season. Near Londa in the Belgaum district there is one about 60 yards wide, flowing over schistose and granitic rocks with quartz sand and pebbles in the stream bed The trees along the banks show evidence of strong floods during the monsoon rains as the trunks are covered high up with patches of grass and vegetable débris. The roots are often exposed by the strong currents washing away the alluvial soil of the banks. The principal trees along these banks are Vitex Leucoxylon, Hopea wightiana (sometimes bearing abnormal leaves 14 inches by 6). Cinnamomum zeylanicum, a variety with small leaves, Eugenia Heyneana, E. zeylanica, Mangifera indica, Pongamia glabra, Calophyllum Wightianum, Aporosa Lindleyana, Ficus glomerata and fine clumps of the thorny Bambusa arundinacea. Maba nigrescens, Ixora coccinea, Strobilanthes ixiocephalus, Dalbergia tamarindifolia and a Crinum in the marshy places, are all common species in this locality. Tamarix ericoides, rare in the beds of the North Kanara rivers, becomes quite common further north particularly in the Konkon and Deccan districts. It is also found near streams in the Surat Dangs. Tamarix gallica, and T. dioica, are associated with Populus euphratica, along the banks of the great Indus river in Sind and furnish the principal fuel used in that district.

DUNE AND HILL FORESTS.

These usually small or medium sized tree forests consist of evergreen mixed with deciduous species, the latter of Deccan type They cover the sandy or rocky foreshores as well as the hills near the sea from Bombay southwards. The rock formations are trap towards the north and lateritic, granitic, gneissic or schistose along the North Kanara and Portuguese coasts. The heavy rainfall, generally poor rocky or sandy porous soil and proximity to the

sea are the principal factors affecting the vegetation. The flora of this humid region is very varied and mostly of Malabar type. There are, however, few of the trees characteristic of the tropical evergreens and the presence of some species of the deciduous Deccan flora such as Acacia Catechu, Sterculia urens, S. colorata, etc, are interesting features of this vegetation. In North Kanara on the low level laterite close to the sea, the rocks are covered with a growth of deciduous and evergreen, mostly thorny shrubs. Canthium parviflorum, Memecylon edule, Flacourtia sepiaria, Ixora coccinea, Vitex Negundo, Acacia Catechu, Carissa Carandas, Randia dumentorum and R. malabarica form clumps of vegetation respected by man and beast. The red flowers of Ixora and the beautiful blue Memecylon inflorescence give a touch of colour to these patches of green vegetation. The demand for leaf manure along the Kanara coast is very great and the tree vegetation suffers and is modified in consequence. Sapium insigne and Strychnos Nuxvomica protected by their poisonous qualities, are often the only trees left. Quite close to the sea on the sandy or laterite soil but above high water mark in favourable situations we find thickets of Clerodendron inerme, Premna integrifolia, Calophyllum inophyllum, Vitex Negundo, V. trifolia, Calamus Thwaitesii, Salvadora persica, and the naturalised Anacardium occidentale, this latter usually affording symbiotic residence to hosts of red ants. This as well as the planted mango suffer from the attacks of Loranthus elasticus, in the North Kanara district. Pongamia glabra and other pods and seeds carried down by rivers are thrown up on the sand and freely germinate but seldom long survive in the poor sandy soil. Spinifex and Ipomoea biloba are as elsewhere along the Indian coast common and abundant. The latter plant is often the host plant of the twining parasite Cassytha filiformis, which is found but rarely on the Spinifex. Near Bombay from the Thana to the Surat district a small bushy Indigofera covers considerable areas of the sandy foreshore. The screw palm, Pandanus furcatus, with yellow orange fruit and odorous bracts, sometimes associated with Vitex Negundo, and other plants is found along the coast near the sea in various situations

Cocoanut and Borassus palms, the latter sub-spontaneous in the districts near and north of Bombay, are conspicuous in the landscape. Considerable plantations of *Casuarina equisitifolia* have been made all along the Bombay coast, which seem to thrive better in the North Kanara district than elsewhere. Amongst the trees cultivated for their economic uses, Mango, Calophyllum inophyllum, Artocarpus integrifolia, Spondias mangifera and Tamarindus indica are a few of the principal. The sacred Ficus religiosa is commonly planted near villages and temples. In North Kanara and Goa clumps of the nearly solid bamboo Oxytenanthera Stocksii are found on the borders of cultivated lands and near habitations.

Lawsonia alba, Jatropha Curcas and J. gossypifolia are common in hedges or sub-spontaneous in most places near the sea. In the Surat district the African Baobab, *Adansonia digitata*, is frequently met with near the coast, a remarkble survival of ancient Arabian introduction In the North Kanara district and northwards to Bombay, on the hills and spurs of the ghats close to or near the sea we find forests of small evergreen trees mixed sometimes with deciduous species. These forests when protected from the villagers and the cultivator's axe form usually a dense growth of small stems without the great high timber trees characteristic of the tropical evergreens. Amongst the more interesting features of this coast hill flora is the presence of a number of dry zone deciduous plants, Zizyphus Jujuba, Bombax malabaricum, (B. insigne is also common), Acacia Catechu, Sterculia urens, S. colorata, Odina Wodier and Moringa pterygosperma. The mass of the flora is, however, nearly evergreen owing to the moist climate and these forests are therefore generally protected from the action of annual fires. The soil is well covered and the vegetation is, taken as a whole, rich and varied.

In the northern coast hill forests of Kanara, Eugenia caryophyllæa, and Memecylon edule are perhaps the most common trees, Diospyros Candolleana, D. microcarpa, Pittosporum dasycaulon and Acronychia laurifolia, Erythrina stricta, Premna integrifolia, Holigarna ferruginea H. Arnottiana, Macaranga Roxburghii,

Ficus callosa, F. tomentosa (also growing on laterite rocks washed by the sea spray), Gymnospo ia Rothiana, Aglaia littoralis, Ixora brachiata, two species of Arg, re.a and Ochna squarrosa are found on the so ithern ghats. Hib scus furcatus, Carissa macrophy,la, Allophylus Cobbe, Vitis gigantea, V. indica, V. sp. near V. elongata, Leea aspera and L. crispa are common shrubs and climbers. Along roadsides, banks of streams and in abandoned fields in the Coompta and Honawar talukas, Mimosa pudica is widely spread There are also a multitude of other species. In the southern part of Kana a the grand "Tale" palm (Corypha umbraculifera) is locally greg irious and abundant, it is also found *in the undergrowth at the base of the Arbail ghat as far* as Sunksal (no large trees). In the Honawar sub-division the Forest Department roughly calculates the annual yield of the "Tale" forests at 2,000 stems. The pith of this palm yields a coarse flour in great demand amongst the coast villagers. The leaves and seeds are valuable bye products. In the Kumta sub division Diospyros cordifolia, Ixora brachiata, Garcinia indica and other evergreens are mixed with Zizyphus Jujuba, Odina Wodier, Garuga pinnata and Acacia Catechu Uvaria Narum, Derris scandens and Connarus mono arpus are a few of the more common scandent shrubs in and alo g the borders of the forests. The remarkable association of d ciduous Deccan species and Malabar evergreens is found in every kind of combination according to the more or less fertile condition of the soil. The demand for timber, firewood and leaf manure from the densely populated coast villages adjacent to these forests has had its effect on the constitution of the flora of this region. In the Thana district north of Bombay, the Decca i and intermediate floras are mixed, there are also a number of M labar (Malayan) types. Teak, Nana, Terminalias, Xylia, etc., are the principal prevailing species. The trees arrive to fair dimensions owing to humidity and favourable soil.

From Anmode and Ju lepet in North Kanara northwards through Goa and Belgaum British) territory are large tracts of mountainous ghat country covered with high level laterite usually

overlying basalt or trap. This ferruginous red or brown coloured clay formed from the denudation of the underlying formation is quite soft when freshly exposed to the atmosphere. After a short exposure it becomes vesicular and one of the hardest and intractable rocks, decomposing with difficulty. The evergreen element is predominant in the edaphic flora covering this area. Small tree forests of variable density, enclosing in the more favoured localities, irregular patches of tropical evergreens with the usual characteristic Myristicas, laurels, palms and lianes, alternate with large open areas covered with colonies of various Strobilanthes. Spear grass (Heteropogon contortus) and other Andropogoneæ (Rottbœllia divergens, etc.), mixed with Blumeas (B. oxyodonta and others), Vernonias, Senecio belgaumensis, S. Grahami, Smithia setulosa, Leea aspera, Alysicarpus racemosus, and prickly, prostrate Acanthaceæ are common. Vigna vexillata Rubia cordifolia, Vitis, sp. (near V. elongata), Lettsomia elliptica, Ipomæa barleriodes, Rourea santaloides and Grona Dalzellii are some of the more abundant climbers. Strobilanthes sesselis, var. Ritchiei is widely spread over this part of the ghats, usually growing in small clumps of 30—40 simple stems, several feet high This gregarious shrub flowers generally only once every seven years like S. callosus and S. membranaceus. The blue flowers of isolated clumps appear during September and October and are conspicuous along the ghats in open situations S. callosus, S. membranaceus and S. Neesianus, this latter flowering annually during the hot season, are in a lesser degree striking objects in the open landscape. Ligustrum neilgherrense, Indigofera constricta, Osyris arborea, Lasiosiphon eriocephalus, Glochidion velutinum, G lanceolarium, Rauwolfia densiflora, Wendlandia Notoniana, Olea dioica, Phœnix humilis, Royle, var. pedunculata, both the stemless and the tree form are prevailing small trees or shrubs and Scutia indica, *Jasminum arborescens, var. latifolia, Uvaria Hookeri, Fagræa obovata, Rourea santaloides, Hippocratea indica, and H. obtusifolia are amongst the most common and

* This species is stated by Dr. T. Cook to be identical with Jasminum malabaricum, Wgt. "Flora of Bombay, p 112, Vol. II.

widely spread of the woody scandent and climbing shrubs in these small forests confined to and characteristic of the hard high level, porous laterite which covers such considerable areas of this part of Western India.

In the Supa Taluka of North Kanara near Kalpa at an elevation of over 3,000 feet the higher levels are open, grassy plains or rounded, bracken covered hill tops. The ravines and valleys contain small tree forests similar in appearance to those of the Nilgiris. The climate is exceedingly moist and the tree stems are even in the dry season clothed with Trichomanes dipunctatum, Peperomia Wightiana, Adiantum lunulatum, Lycopods, Mosses, Fruticose lichens and Utricularieæ. The great rounded snowy tops of the flowering Nana (Lagerstrœmia microcarpa) trees are conspicuous during the hot season. In this locality Eugenia memecylifolia grows gregariously in shady places at the highest elevation (3,400 feet). Euphorbia linearifolia, a rare species, was found abundant in the grassy uplands. The handsome Amaryllideæ (Pancratium parvum) is conspicuous in places. The usual trees and shrubs found on laterite, also Casearia graveolens, Symplocos Beddomei, Randia uliginosa, R. dumentorum, Tabernamontana Heyneana, Wagatea spicata, Celtis tetrandra, Ficus Tjakela, and F. gibbosa, form the mass of the woody vegetation.

Further north the high Mahableshwar plateau is covered with a dense growth of small, stunted evergreen forest. The trunks of the trees are very short and thick, with long irregularly spreading branches, and the average height of the canopy does not exceed 30 feet. On the laterite soil the flora is poor in species. The principal trees are Lasiosiphon eriocephalus, Randia dumentorum, Actinodaphne Hookeri, Eugenia Jambolana, Mappia oblonga, Glochidion zeylanicum and Terminalia Chebula. Ligustrum neilgheerense, Solanum giganteum, Salix tetrasperma, Pygeum Wightianum, Litseæ Stocksii and the Choua bamboo are less abundant in the growing stock. Strobilanthes callosus, S. ixiocephalus, Osyris arborea, and Crotalaria Leschenaultii, called by Graham the glory of Mahableshwar, are very common shrubs. The principal climbers on the plateau are Lettsomia elliptica,

Argyreia Hookeri, Allophylus Cobbe, and Acacia intsia. During the rainy season Hitchenia caulina, Senecio Dalzellii, Phaseolus grandis, Impatiens Dalzellii (the yellow flowered balsam), Asystasia violacea, Adenoon indicum, Centotheka lappacea, and many other grasses and herbs are widly spread throughout this elevated region. The bracken is as usual common in open situations.

(*To be continued.*)

SAL COPPICE WITH STANDARDS

BY F. A. LEETE, F.C.H.

The enclosed photographs were taken in the Charda Sal Forest, Bahraich Division, Oudh Circle. No. I was taken in April 1899, just after the completion of the fellings, and No. II within a few yards of the same place in the following November.

In seven months the average height of the coppice growth was fully 6 feet, and many individual shoots were as much as 10 feet high. The marks on the staff in the foreground of No. I were at 5, 10 and 15 feet respectively from the ground.

Very few of the trees in the forest were more than 3′ 6″ in girth, and the average of the standards was from 2′ 6″ to 3′ 0″ About 60 were left to the acre.

EFFECT OF LAST WINTER'S EXCEPTIONAL FROST ON THE FOREST GROWTH IN THE LAHORE FOREST DIVISION.

BY ATMA RAM, EXTRA ASSISTANT CONSERVATOR OF FORESTS.

The forests comprised in this division are situated in the plains of the Bist and Bair Doabs and consist of natural forest and plantations.

The principal forest trees are the following:—

Shisham (Dalbergia sissoo).

Tut or Mulberry (Mor alba and M. indica).

Kikar (Acacia arabica and A. modesta).

Charda Sal Coppice with Standards, Bahraich Division, Oudh. View taken in April, 1899, just after completion of fellings.

Farash (Tamarix orientalis)

Jhand (Prosopis spicigera).

Karil (Capparis aphylla).

Pila (Salvadora oboides)

The above are all hardy species, withstanding well the extremes of heat and cold found in this province. Last winter, however, owing to the excessive cold, they all suffered in the order above mentioned.

Early in December last the trees began to shed their leaves and were quite bare by January. In February the Pila, which is almost evergreen, assumed a palish appearance, its thick green foliage shrivelling up and turning yellow The effect of the frost on imported species of bamboo (Dendrocalamus strictus?) and on mango trees was disastrous. Many clumps of bamboo were killed outright, and although precautions were taken to preserve the young mangoes by covering them all round with thatch, many were found dead on the removal of the thatch in April. Plants of Eucalyptus citriodora planted out in July 1904 suffered severely, and their stems were dried up, but the roots survived and sent up shoots in the spring. Plants of E. globulus of the same age, however, showed no signs of injury. As a result of the frost all species were very late in putting out new leaves, and in all cases their reproductive power was considerably diminished. The acacias produced no seed, and the shisham, whose seed is generally abundant, very little. After the thaw many instances of frost-crack were found on shisham and many trees of this species which from any cause were not in flourishing circumstances were killed outright.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE TREATMENT OF ELEPHANTS' HEADS BY INDIAN MAHOUTS

Could you or any reader explain the reason for daubing mustard oil on an elephant's head as is done by Indian mahouts belonging to the P. W. D. and Military Transport? I see in Vol. III, page 181, Roger's "Manual of Forest Engineering for India" that Mr. Fordyce, Deputy Conservator of Forests, states that mustard oil should be given to the mahout and care taken that it is applied to his charge's head.

I have never seen a timber trader's animal's head thus annointed, nor have I seen a Forest elephant in Burma smeared with oil, and up to date I have always thought it was some useless custom peculiar to Indian mahouts which, among other advantages, attracted the sun on to the poor beast's skull, but when I see a Forest Officer recommending this treatment, I begin to think, perchance, there is something in it. The book gives no reason, hence my letter, as personally I would have advocated whitewash if any dressing on the head was required.

RUBY MINES DIVISION,
Burma.

C. BRUCE,
Deputy Conservator.

EXTRACTS FROM OFFICIAL PAPERS.

TASMANIAN TIMBERS

In his preliminary report on Australian woods Mr. James Adam, Executive Engineer P. W. D., India, in referring to the timber resources of Tasmania, wrote that the official information published by the Colony was "much lacking in the essential detailed particulars,' and further that "there were also somewhat serious discrepancies, and certificates from the railway officials, actually using the timbers as sleepers were absolutely wanting." Mr. Adam went on to say that, on this being pointed out to the Premier of the Colony, "he was good enough to issue instructions for the preparation of a special report on the subject." It is probably as one result of these representations of Mr. Adam that we have just received from the Honourable Mr. Alexander Hean, the Colonial Minister of Lands and Works, a copy of an official publication entitled 'Tasmanian Forestry, Timber Products and Saw Milling Industry,' and we have much pleasure in commending the volume to the attention of the large and growing circle of Engineers in India who have recognised the advantages that accrue from the use of some of the Australian woods. The expansion of this trade is very clearly shown by the increasing imports of Australian sleepers at the chief Indian ports, and particularly at Calcutta. "Tasmanian Forestry" has been compiled by Mr J. Compton Penny, Chief Forest Officer, under the superintendence of Mr E. G. Counsel, Surveyor-General and Secretary for Lands, and sets out a description of the timber trees indigenous to Tasmania, their commercial value and the process of manufacture, with particulars of the methods adopted by the Colonial Government to foster the industry. In the increasing trade in Australian woods to India and South Africa, thus far, Tasmania has not taken a very large share, but recent engineering operations have directed attention to some of the special requirements which Tasmans' land timber is particularly able to meet. In

the execution of the new great national harbour works at Dover large quantities of Tasmanian timber have been used by the contractors, Sir Weetman Pearson and Son, Ltd., with very satisfactory results. Some idea of the extent of these operations is suggested by the quantity of timber required for the temporary work, &c., which is stated by Mr. Harold J. Shepstone, in the *Scientific American*, to have amounted as a minimum to the following: hardwoods, principally greenheart and rock elm 25,000 cubic feet; soft woods, pitch pine, redwood, &c. 75,000 cubic feet for permanent works. For temporary work, 550,000 cubic feet of Blue Gum and other hardwood, pitch pine, &c., for superstructure, 850,000 cubic feet or some 1,500,000 cubic feet in all required in the construction of a total length of 9,520 feet of piers and breakwaters, so that the works at Dover provide an exhaustive test of the suitability of timbers. For the temporary staging Tasmanian Blue Gum piles are being principally employed, as this wood resists the attacks of the *Teredo navalis* or seaworm. Mr. Shepstone writes:—

"Some idea of the density of this wood may be the better understood when it is stated that it has a specific gravity of 75 lbs. to the square foot, whereas water is but 65 lbs. A pile of Blue Gum, therefore, 100 feet long and 20 inches square, would turn the scale at nearly 10 tons, while an Oregon log of similar dimensions, having only a specific gravity of 48 lbs per square foot, would only weigh 6 tons, and consequently float.

"To obtain a pile 100 feet in length and 20 inches square, parallel from top to bottom demands a tree 15 to 18 feet in girth, 5 feet from the ground, and about 150 feet to the first branch. The Tasmanian Blue Gum, easily attains this height. Indeed, so far as height and general beauty are concerned, the Blue Gum is no mean rival to the famous redwoods of California. A large quantity of the timber to be seen at Dover came from the yards of Messrs. Gray Brothers, of Adventure Bay. Mr. Gray, the head of the firm, states that they often come upon trees from which they could cut piles 160 feet long (that is, 60 feet longer than required by the contractors at Dover) before the first branch is reached, and others 230 feet high measure 7 feet through at the butt. Nor are these figures by

any means the largest recorded for Tasmanian Blue Gum. Mr. Perrin, formerly Inspector of Forests in Tasmania, and afterwards in Victoria, mentions having measured a fallen Blue Gum at Geeveston (on the Huon River) which had a length of 330 feet; and Mr. R. M. Johnston, the eminent Government Statistician, speaks of the 'Tolosa Blue Gum,' also 330 feet high; and Baron von Mueller, the well-known Australian naturalist, says of a Blue Gum growing at Southport in Tasmania that it contained 'as much timber as would suffice to build a 90-ton schooner.' And when speaking of these giants, it should be borne in mind that they are not isolated cases, mere curiosities, but that trees of from 200 to 250 feet are *fairly common in the forests, extending over* thousands of acres in the Huon and Peninsula districts of Tasmania, rising high and clear of boughs, like the masts of great ships."

The official manual now before us states that a Blue Gum tree of full growth will average 7 feet diameter at the butt, 100 feet in length to the lowest branches, and from 200 to 250 feet in extreme height, taking probably three to four hundred years to attain its full dimensions. For wharf and bridge construction for piles and the heavier timbers of superstructure, it is superior to anything produced in the Australian States. For bridge or wharf decking it would be hard to find its equal for durability if laid when thoroughly seasoned. For the Dover works several shipments of Blue Gum piles, hewn square to 18 × 18 and 20 × 20 from 70 to 100 feet in lengths, with a large quantity of sawn timber in junk sizes, were supplied from Southern Tasmania. The high specific gravity of the timber, its capability to withstand hard driving and its partial immunity from the ravages of the teredo render Blue Gum specially adapted for piling purposes. It is used also largely for railway sleepers, railway wagon work and wheelwright purposes.

Writing of Tasmanian woods for sleepers, Mr. Adam said that while the hardwoods are much less numerous than is the case on the mainland, there are 14 species of Eucalyptus attaining size enough to yield timber, but only three are suitable for sleepers, and of these two only are obtainable in sufficient quantities

for export The two being "Tasmanian Blue Gum" (*Eucalyptus globulus*) and Tasmanian stringy bark (*Eucalyptus obliqua*) Of this latter "Tasmanian Forestry" says, "Stringy bark, so called as its name implies, from the fibrous nature of its bark, is probably the most valuable tree that Tasmania possesses, inasmuch as it produces a timber of excellent quality, suitable for all constructive work and by reason of its general distribution throughout the island, gives the supply of timber requisite for extensive saw milling operations. The average tree at maturity is of even greater dimensions than the Blue Gum, often attaining a height of 250 feet, with a diameter of from 12 to 14 feet at the butt. The wood is, generally speaking, more open and free in grain and of lower specific gravity than Blue Gum, but equally durable and adapted for many similar purposes for which that timber is used, such as in piles, wharf and bridge timbers, &c. For mining purposes, (underground and surface work), it is largely in demand. Railway sleepers have a life equal to, if not greater than, Blue Gum. Wood paving is also one of the uses for which Stringy-bark is well adapted, possessing as it does the requisite qualities for that purpose, *viz.*, durability under wet and dry conditions, evenness of wear, with a minimum polish under traffic." The official handbook goes on to say that "prejudice to Stringy bark timber is sometimes set up by the appearance of seasoning cracks which mostly appear in the ends of the freshly cut timber – when cut green and exposed to stringent conditions of sun and wind These although not desirable so far as appearance is concerned do not really affect strength and durability. The cracks at first noticeable gradually close as the process of seasoning proceeds, until the whole piece again becomes thoroughly consolidated Other 'hardwoods' described are Ash or Swamp Gum which cannot be classed with Blue Gum or Stringy-bark for durability); Gum Top Stringy-bark, largely used in house construction; Peppermint and Ironbark, both the latter being consumed in local requirements. The foregoing timbers are dealt with in Section I. Section II describes the Tasmanian "ornamental and other timbers" Section III is devoted to "Secondary Forest trees," producing either timber not in general use, or of a nature

termed "Fancy Wood" Section IV gives Botanical descriptions of the Tasmanian *Eucalypti* by Mr. L. Rodway. Section V traces the history and growth of the Saw-milling Industry of the Colony. Tasmania has long been well to the fore in this direction, for in 1851, one piece of Blue Gum measuring 146 feet in length, 18 inches × 6 inches, sawn clear of heart and sap, was cut at Long Bay, D'Entrecasteaux Channel, and forwarded to the first Exhibition in London. The Tasmanian record for the longest piece in one length is 160 feet. This section closes with the specification for railway sleepers and other timbers for export where the Government certificate is required and the form of certificate. Section VI consists of a number of reports on the utility of Tasmanian woods, including one from Mr. C. C. Nairn, Chief Engineer for Existing Lines, Tasmanian Government Railways. Section VII gives the results of a number of tests carried out on Tasmanian timbers in comparison with English Ash, Beech, and Oak. Section VIII sets out the Regulations under "the Crown Lands Act" of 1903, with the scale of License Fees for timber cutting. The work is copiously illustrated throughout and includes a large map of Tasmania.

Some years ago in these columns a leading Indian Engineer took the Indian Forest Department somewhat to task for its comparative neglect of the commercial possibilities of the timbers of the great forest reserves of India, and his remarks called down on him strong protests from Forest officers. Perusing this excellent Manual of Colonial timbers produced at the suggestion of an Indian Engineer, it occurs to us that the Forest Department of India might do worse than follow the lead. *In the Indian and Eastern Engineer*

In our review of Mr. Maiden's notes on the Commercial Timbers of New South Wales *vide* page 98 of volume XXI), we have already drawn attention to the necessity which exists for the preparation of such a hand-book.—HON. ED.

Chaubattia bungalow with the Snows beyond, N.-W. Himalayas.

Photo.-Mechl. Dept., Thomason College, Roorkee.

Photo. by R. G. Milward.

VOLUME XXXII NUMBER 2

INDIAN FORESTER

FEBRUARY, 1906.

THE UNITED STATES FOREST SERVICE.

We publish elsewhere the Secretary of Agriculture's report on forest progress in the United States. The report is of such high interest and the praise of the value of the work of the Forest Service so unstinted that we feel no apology is needed for printing the note in full.

The United States Forest Service actually came into existence as an administrative organisation on the 1st February 1905, the care of the whole of the National Reserves being then transferred to its charge. Every thing affecting the reserves is now determined or executed by men of expert knowledge, familiar with local conditions. Especial attention is drawn by the Secretary to the fact that the entire force has become a part of the classified Civil Service. In this fact alone we see the full realisation by the Americans of the real part played by the forest in the economy of the State in that the very existence and well being of the community depends entirely upon the maintenance of a certain area under forest and upon the proper management by

experts of the lands, whether State or privately-owned, so maintained.

Commenting upon the urgent need of forestry in his country the Secretary points out that a time had arrived which presented at once an opportunity and a crisis. Forest destruction had reached a point at which a not distant end was perceivable. There were few who believed that the conflicting interests could be reconciled during the lives of the present generation "That the whole situation is profoundly altered is directly and chiefly due to the work of the Forest Service." High praise indeed, from the Secretary responsible for the Department Dealing with the financial aspects the Secretary states that a far more complete control (over the forests) is exercised than formerly, yet the net cost to Government of all the work of the Service will be less for the present year than that of the Bureau of Forestry alone before the transfer. A property worth in cash not less than $250,000,000 is administered at a cost of less than one-third of 1 per cent of its value, while increase in that value of not less than 10 per cent per annum is taking place As the use of the reserves increases the cost of administration must, of course, become greater also, but receipts will certainly rise much more rapidly. The forest reserves are certain not only to become self-supporting but a source of large public revenue

The Sister Service in India offers a hearty welcome to its young cousin in the New World and its sincerest congratulations on the unstinted praise accorded to its work in the Secretary's first report.

FOREST MUSEUMS

II. THE GASS FOREST MUSEUM

In our last issue the question of the creation of Provincial Forest Museums was discussed and the great usefulness of such, both to Local Governments and their departmental officers, pointed out. We drew attention to an excellent institution of this nature, the Gass Forest Museum at Coimbatore, Madras, whose inception and creation was due to the initiative of Mr. Gass, Conservator of Forests, Southern Circle.

We propose here to shortly describe* the arrangement of this Museum in the hope that the notes will prove of use to others wishing to follow in the path so well marked out.

The Museum was commenced in 1901, when Mr. Gass began the collection of specimens of timber and other forest produce and set apart one of the large rooms of the Conservator's office for the purposes of a Museum. At this period he intended to limit the collections to the Southern Circle Specimens began to arrive in February 1902, and their numbers increased rapidly During a portion of this year Mr. R. D Richmond, Assistant Conservator of Forests, was placed in charge of the arrangement of the specimens under the direct supervision of Mr. Gass. In April H. E. the Governor Lord Ampthill visited the Museum and recorded his warm appreciation of the departure. Since His Excellency's visit the collections have been open to the public daily. It was soon seen that it would be an advantage to throw open the Museum to the whole Presidency and the articles now exhibited come from the three Circles. Owing to the great increase in the number of specimens received it was found necessary to add a room from the District Forest Office adjoining the Conservator's Office, thus doubling the available space. This arrangement has not, however, proved satisfactory, and Government, recognising the importance of the institution, have now sanctioned a new building expressly for Museum purposes; this building is now in process of erection, and when finished the 3,000 specimens collected will be transferred to it

Turning to the arrangement of the collections, Series I consists of 314 specimens of timber, bamboos, &c., the chief timbers being shown in sections, panels and blocks. As examples of the longevity of the lives of some species of trees, a specimen of teak presented by the Cochin State is considered to be 455 years of age, a similar section of rosewood from the same State being 410 years. Sections of the teak from the Nilambar plantations are also exhibited. Amongst the items classed under this series (wrongly so we think)

* An able note upon this Museum appeared in the *Madras Mail* of October 5th, 1905.

are the fruits and seeds of forest trees, fibres (81 varieties), gums (40) and resins, and vegetable dies and oils (28). Series II consists of bamboos, canes, reeds, creepers, &c., -115 specimens in all. The numerous uses to which the bamboo is put by the jungle tribes are shown here. Series III deals with injury to growth, specimens of timber affected by forest fires, insects, and parasitic growths. Series IV Geological specimens (no mention is made as to whether the various kinds of soils of the Presidency are shown) and Series V Entomological specimens follow, the latter naturally very incomplete at present. Birds and birds' eggs would appear to be also included here, and the series would perhaps be better entitled (together with the next Series VI which exhibits 139 specimens of skins and skulls) Zoological specimens. Series VII is devoted to a collection of weapons and implements used by jungle tribes, whilst the next series (VIII) contains 24 kinds of snares and traps used by the hill tribes for taking game. Series IX exhibits ornaments worn by the hill tribes and X a small collection of their musical instruments. Series XI is probably one of the most interesting to the visitor. It consists of 70 models illustrative of forests operations, boats in use on the rivers, forest bungalows, &c. For example, a model shows the wire rope way at Mount Stuart, others an elephant pit, kraal with a captured elephant and an elephant tamed and at work dragging timber. Other models show coppicing operations. Series XII is a collection of portraits and pictures of forest scenes. Lastly, Series XIII consists of minor items which cannot be included under other heads, such as honey, wax, rubber. These, we think, would have been more in place had they been classified with the gums and resins and oils as "minor produce."

It has not been our purpose here to in any way criticise this excellent institution but rather to hold it up as an ideal to be followed in other Provinces. As experience is gained a more elaborate and minute system of classification of the objects exhibited will doubtless be evolved. Meanwhile we are of opinion that the existence of the Gass Forest Museum places the officers of the department in Madras in a position to be envied by their confrères in other Provinces of India.

SCIENTIFIC PAPERS.

CHICKRASSIA TABULARIS.

BY M. RAMA RAO.

In Hooker's "Flora of British India," and in Brandis' "Forest Flora of North-West and Central India,' the capsule of this tree is described as 3-celled. When I was stationed in the Salem District I examined the capsules of this species on more than one occasion and in different localities, and found them to be generally 4 celled, with only a few 3 or 5 celled capsules. In other respects, the description of the species given in Hooker's Flora agreed with the specimens examined by me I should be extremely interested to hear whether the information in the above-quoted works is based on an examination of a large series of capsules of this species collected in different localities. Otherwise it would appear that the floras require alteration on this head.

As regards the size of this tree none of the Floras consulted by me, nor Gamble's Manual, give any idea of the dimensions attained by this species, beyond saying that it is a large tree. I happened to see a few splendid specimens on the Yelagiris preserved in temple poramboke. The largest of them girthed 18 feet at breast height with a straight and clean bole of about 45 feet to the first branch It was quite healthy, sound and vigorous. The Yelagiri *Malayalies* call it *Sellangatchi*, while on the Melagiris of the same district, it is called *Gantamalı*.

It occurs on all hill ranges of the Salem District above 2,500 feet. Reckless fellings in the past have left but few specimens of large size, which are chiefly confined to temple groves, religiously protected by the hill tribes.

ORIGINAL ARTICLES

THE DISTRIBUTION OF THE FOREST FLORA OF THE BOMBAY PRESIDENCY AND SIND.

BY W. A. TALBOT, ESQ., CONSERVATOR OF FORESTS, BOMBAY.

II

EVERGREEN TROPICAL FORESTS.

The evergreen primeval Forests of the Indian Western Peninsula extend over many square miles of North Kanara, and in the southern talukas of this district, Kumta, Sirsi, Siddapur and Honawar are continuous towards the west. In favourable situations further north, on the Supa and the Yellapur ghats and in the western part of Belgaum, they occur in isolated blocks or areas (locally called Kans or Rais) which are surrounded by dry deciduous and deciduous and evergreen mixed forests of various kinds of cultivation. Outside the limits of these districts some of the ghat region in the Satara Collectorate is clothed with tropical evergreens. The flora, however, of this class becomes less varied and the number of different species diminishes, as we go further north. South of Bombay, outside the Presidency limits (Travancore, etc.), these forests become more perfect with a greater admixture of Malayan elements. The most distinctive character of this evergreen hygrophilous compared with the xerophilous Deccan and the intermediate mixed forests is the presence of Anonaceæ, Guttiferæ, Dipterocarpeæ, *Myristiceæ*, *Palms*, *Malayan types of* Sterculiaceæ, Laurineæ, Euphorbiaceæ, Urticaceæ and other orders not found in the latter.

In a tropical evergreen forest, growing under favourable conditions we find four storeys of vegetation. Immediately covering the soil are seedlings mixed with shrubs and herbaceous species and in the next zone or storey small or medium sized evergreen trees 50–75 feet high. The top canopy of great evergreens, often 150 feet above the ground is crowned by giant, sometimes deciduous trees, of which Tetrameles nudiflora is one of the most common

and remarkable. The tree stems are in many instances covered with epiphytic Utricularias, Orchids, Aroids and Ferns (Drynaria quercifolia, etc.)

In North Kanara where the evergreen tropical Kans are contiguous to or surrounded by mixed deciduous forest the divergence between the classes of vegetation is very striking. There is considerable physical relief in passing abruptly from the strong glaring sunlight of the open deciduous jungle in the hot season to the cooler atmosphere and deep, somewhat gloomy shade, of the lofty evergreens. The bewildering diversity, height and size of the trees, the universal green and general absence of colour, the great climbers with fantastic shaped stems, the epithytic orchids, aroids and ferns, the general stillness and apparent absence of animal life, appeal to the naturalist, who is satisfied that here at least the action of man has not affected and changed the original flora of these truly primeval forests. The principal forces of nature are in constant action, and there is no annual period of rest, corresponding to the winter in temperate and arctic regions or the hot seasons in the dry tropics. On the shady, moist, well covered soil, the growth is continuous and the struggle for existence amongst the many species in the zones of vegetation is very great. The principal causes preventing the predominence of any one genus or species over more than a limited area are to be found in the very favourable conditions in which this strongly differentiated and extremely rich flora is placed. Many of the species are rare and confined to special localities. For example, Pinanga Dicksonii is locally abundant only on the Gersoppa and Nilkund ghats of North Kanara Alsodeia zeylanica, Erythropalum populifolium, Apodytes Beddomei, Solenocarpus indicus, and several other plants have each been collected but once and may not be again met with for a long time in these evergreens. It is very difficult to correctly identify on the spot many of the high trees growing in the Kans. The rapid and continuous growth produces generally a thin, smooth, greyish bark with scarcely any rhytidome. The great height of many of the stems prevents examination of their foliage, the flowers are also often inconspicuous and

appear at different seasons of the year. These together with the diversity of the species, makes a satisfactory interpretation of the flora almost impossible. In the smaller less varied and more open deciduous forests such examination is not attended with similar difficulties. It is of common occurrence to see a tall tree in full bloom in the evergreens and to be unable to procure specimens of the flowers, except by felling or sending up a native climber, both usually very tedious operations Much of the evergreen region of North Kanara is somewhat difficult of access, as the dense undergrowth often bars the way of the observer. The forest pathways are also usually bounded by monotonous walls of verdure, without the relieving colour of conspicuous flowers. However the five or six zig zag ghat roads from the Kanara uplands down to the coast afford excellent opportunities for observing this interesting and varied flora. The tropical evergreen forests covered a much greater area formerly in the Sirsi and Siddapur talukas of North Kanara than they do in the present day. The supari palm (Areca catechu) cultivation has destroyed thousands of acres of fine forest and has laid waste a considerable extent of valuable territory, and this denudation is continually going on as the areca nut palm plantations require for leaf manure an area of forest six to nine times as great as the extent of the actual plantations themselves. There is also the cutting of what is termed "wet or ground betta" required for this cultivation which involves the destruction of the undergrowth mostly outside the allotments for dry "betta" (tree loppings) made to the garden owners. Evergreens in all stages of decay may be observed and when these disappear, the gardens in their immediate vicinity naturally follow. The wasteful management of the North Kanara betta assignments and destruction of the Kans has been strongly opposed by the Forest Department for many years. The supari garden cultivation principally affects the tropical evergreens which disappear sooner or later under the destructive treatment, and the Haigas often hasten the complete destruction of the tree vegetation by burning the more or less denuded area of their "bettas" for cattle grazing purposes. As long as there is jungle in the vicinity of their

gardens these people pay little attention to the requirements of future generations. There is another forest destroying agency at work in the Bombay Presidency, namely, Kumri cultivation. Patches of forest, evergreen or deciduous, usually on the slopes or tops of hills are felled and the timber burnt; fortunately the evergreen tropical forest were formerly avoided by the Kumri wallahs, as the labour of felling the high timber was too great. The burnt surface is rudely tilled and sown with Eleusine corocana (ragi) and if allowed the same area is re-kumried the following year, when the place is abandoned and a new wooded area selected. These patches of re-kumried forests require many years, probably centuries, before they are reconstituted. Thousands of acres of bare hill tops are conspicuous evidence of the effect of this destructive cultivation in the Honawar, Kumta and Ankola talukas of North Kanara. Many of these ancient kumries are now covered with colonies of Stobilanthes (S. callosus, etc.). Usually where the soil is of fair quality and evergreens and deciduous forests are contiguous the once destroyed evergreen flora is replaced in the course of time by a growth of deciduous species. I do not think, however, that the foregoing destructive agencies have as great or far-reaching effect on the constitution of the evergreen forest flora as the annual forest fires and continual goat browsing have on the deciduous forests of the dry districts.

The abandoned bettas and kumri lands in the course of time, if left to themselves, are gradually recovered with forests. The surrounding usually varied flora and a heavy rainfall are conditions favourable to the reconstitution of the denuded area, and although the process may take a very long time it is certain in the end. On the other hand, the Deccan forests under the unfavourable conditions of a scanty rainfall and with the destructive annual fires which traverse such large areas, have little chance of recovery. The flora of this region becomes poorer and poorer in the number and size of the constituent ligneus species, until ultimately little or no tree vegetation remains.

The Bombay tropical evergreens cover a comparatively small area when compared with those of the Malay Peninsula and

Burma and do not contain nearly so rich a flora. For example, taking four characteristic Malayan natural orders the number of species in each flora is as follows:—

1.	Guttiferæ	M	66
		B.	20
		N. Kan.	11
2.	Myristiceæ	M.	47
		B.	9
		N. Kan.	4
3.	Palmeæ	M	142
		B.	53
		N. Kan.	8
4.	Anacardiaceæ	M.	67
		B.	35
		N. Kan	8

A very large proportion of the genera of Malayan origin in North Kanara contain only one species each, and if there are several as, for example, in Myristica and Amoora, these are well differentiated and distinct, which points to an ancient origin. There are nearly 600 species of trees, shrubs and climbers in the North Kanara evergreens, and three hundred and twenty species of woody plants are found in the deciduous mixed intermediate forests and those of the dry Deccan plains. Some of these deciduous species, however, extend into the evergreen zone of vegetation, but the evergreens themselves are not found away from the influence of the heavy rainfall along the ghats. The ten predominant ligneous orders in the North Kanara "Tropical Evergreens" are Euphorbiaceæ, Urticaceæ, Leguminosæ, Laurineæ, Rubiaceæ, Guttiferæ, Dipterocarpeæ, Acanthaceæ, Meliaceæ and Anonaceæ. It is very difficult to place these families in order of predominance, as the species of this evergreen flora are combined in endless variety. For example in the Telgiri Kan near Yellapur (area about 100 acres in extent in Kanara, predominant amongst the undergrowth are herbaceous Vernonias, (V. divergens, and V. indica), Gomphandra axillaris, Rauwolfia serpentina, Justicia wynaadensis, Rubia quadrifolia, Memecylon

Talbotianum, Costus speciosus, Mappia fœtida, Leea sambucina, and seedlings of Cinnamomum and Caryota urens. In the small tree zone Flacourtia montana, Spondias acuminata, Diospyros sylvatica, Litsæa Stocksii, Callicarpa lanata, and strangely enough Pajanelia Rheedii (usually found along river banks and nearly always a rare tree) are common. The ubiquitous and characteristic Caryota urens, Artocarpus Lacoocha, Myristica corticosa and M. malabarica are also abundant in this zone of growth. More than half the large trees forming the top canopy belong to Diospyros microphylla and Polyalthia coffeoides, Dysoxylum glandulosum, Ficus nervosa, F. callosa and Mimusops Elengi are also numerous. In this Kan there are no giant buttressed deciduous species overtopping the evergreens, except a few large and tall stems of Alstonia scholaris. The more common climbers are Gnetum scandens (stems two feet in diameter), Entada scandens and Cansjera Rheedii. Piper trichostachyon, P. Hookeri, the epiphytic narrow leafed Hoya retusa, several species of orchids principally species of Dendrobium, Aroids, Remusatia vivipara, Raphidophora pertusa, and the ferns, Niphobolus adnascens, Vittaria elongata, Pleopeltis membranacea Adiantum caudatum, etc., are abundant on the tree stems. About a mile away towards the west there is another Kan with a quite different arrangement of species. One of the predominant shrubs in the undergrowth there is Psychotria Dalzellii, which grows gregariously almost like a species of Strobilanthes. The small trees are mostly Actinodaphne Hookeri, Cinnamomum zeylanicum, Murraya exotica Litseæ zeylanica, Caryota urens, and Melia dubia. Chickrassia tabularis (Lal devdar) trees are common and of large dimensions in the highest canopy. I had 250 of these latter marked for felling in this "evergreen" in 1886. Nearer Yellapur we find another arrangement in one of the Mundgod road Kans. Here the undergrowth contains Ixora nigricans, Lasianthus sessilis, Chasalia curviflora, Glycosmis pentaphylla, ferns and seedlings of the trees growing in upper zones of vegetation. In the lower small tree zone Aporosa Lindleyana is very abundant and supplies the rafters (Sun nulli) used by the villagers Atalantia racemosa, Memecylon edule, and Ficus asperrima are also prevailing

species. The large trees consist of Mangifera indica, Vitex altissima (common), Ficus callosa Eugenia hemispherica, Antiaris toxicaria and others. Two of the principal climbers in this Kan are Embelia robusta and Ventilago Madraspatana. A few miles from Yellapur, due west towards the Arbail ghat under a heavier rainfall (150 inches annually), the phytographical constitution of the evergreen forests changes, the soil is often stony with sometimes tracts of high level laterite. Strobilanthes callosus, S. Heyneanus, S. lupulinus, S. barbatus and Caesalpinia mimosoides are common and gregarious over considerable areas of the undergrowth. This type changes into hill forests along the Arbail ghat.

There are considerable stretches of forest with few large stems, often a dense growth of small trees with one or more predominant species. Aporosa Lindleyana, Atalantia racemosa, Olea dioica, Nothopegia Colebrookiana, Mallotus albus, Linociera malabarica, Celtis tetrandra, Cleidion javanicum, Harpullia cupanoides, Glochidion Hohenackeri, Mappia oblonga mixed with Cedrela Toona, Sterculia guttata and Holigarna Grahamii, Grewia umbellifera, Beaumontia Jerdoniana and Anodendron paniculatum are prevailing climbers. Crotalaria fulva and Breynia rhamnoides are common bushy shrubs in open situations, and Melastoma malabathricum and Mussaenda frondosa, are usually to be found near streams and in moist places. On the southern ghats in North Kanara from Devimane on the Kumpta Sircy road to the falls of Gersoppa, the Malayan element of the tropical evergreen forests becomes stronger and more varied and there is a preponderance of Myristicas, Dipterocarpeae and great trees of Malayan origin. Many species not at all found or rare in the northern part of the district become quite common. On the Gersoppa ghat large Calophyllum tomentosum, (Poon spar), cylindrical stems with their peculiar characteristic yellowish bark are conspicuous and sometimes associated with groups of a slender dwarf palm, the graceful endemic Pinanga Dicksonii. Myristica magnifica, with its wonderful aerial roots, the immense buttresses of Tetrameles nudiflora, the great trunks of the purple fruited Antiaris toxicaria, the handsome flowers and tubercled stony fruit of Elaeocarpus tuberculatus, the hanging orange coloured inflated

fruit of Harpullia cupanoides, the thorny scaly climbing scandent Calamus Thwaitesii and the short thick stemmed palm, Arenga Wightii, all combine to give a distint aspect to the rich flora of this locality. The peculiar grasses, Panicum pilipes, Centotheka lappacea, and *Ischæmum semisagittatum are abundant in the herbaceous* undergrowth. On the Dodmani ghat further south the most abundant and striking tree is Diospyros crumenata, (hitherto only noted in the Ceylon forests) the great cylindrical trunks of which dwarf the more moderate sized stems of Ailantus malabarica, Mesua ferrea, Artocarpus Lakoocha, Myristicas, Garcinia Cambogia, Diospyros pruriens, D. sylvatica, D. assimilis, Clausena Willdenovii, Sageræa laurina, Chrysophyllum Roxburghii, etc. For several miles near the top of this ghat there appears to be areas covered with Eugenia macrosepala, formerly described as a small shrub but in this locality a small gregarious tree, sometimes mixed with the almost equally common Travancore Lansium anamallayanum and Memecylon Wightii. I found also here and only here the rare climber Erythropalum populifolium, and the still rarer Apodytes Beddomei, a small tree discovered long ago by Colonel Beddome in Travancore.

Near the Gersoppa waterfall, on both sides of the river above the great gorge, the forests contain many wood oil trees (Dipterocarpus turbinatus) with smooth bark and huge cylindrical stems. The pathways and roads are covered in places with their winged fruits during May and June. Elæocarpus serratus, Pygeum Wightianum, Holigarna Grahamii, Nephelium Longana, large trees of Symplocos Beddomei, Pterospermum Heyneanum, and P. acerifolium are a few of the more abundant and common large or moderate sized species. Amongst the smaller trees and shrubs Glochidion Hohenackeri, Cleistanthus malabaricus, Alstonia venenatus, Bragantia Wallichii, Hemicyclia venusta, Dimorphocalyx Lawianus, Blachia denudata, Mallotus albus, Debregeasia velutina, Cleidion javanicum, Boehmeria malabarica, Unona pannosa, Chailletia gelonioides with its peculiar red arillate fruit, Euonymus indicus, Croton Gibsonianus, Psychotria flavida and P. canarensis are some of the principal. The beautiful and ornamental flowered

Thunbergia mysorensis, Anodendron paniculatum, Chonemorpha macrophylla, Ellertonia Rheedii, Dalbergia rubiginosa, D. tamarindifolia, Derris platyptera, Parsonsia spiralis, Mezoneuron cucullatum, Calamus pseudo-tenuis, C. Thwaitesii, Salacia oblonga, Gouania microcarpa and Aeschynanthus Perrottetii are conspicuous climbers and epiphytes. In the deep shade of the undergrowth are five species of Begonia, (B. integrifolia, B. crenata, B. concanensis, B trichocarpa, B malabarica), Piper subpeltatum, Ixora polyantha and a host of other herbaceous species, Carex brunnea, Scleria elata, Gleichenia linearis, Campteria biaruta, Blechnum orientale, Thamnopteris Nidus, Vernonia divergens, Blumeas, and Crotalaria triquetra are found covering directly the deep, moist vegetable mould. These tropical evergreens situated along the crests of the ghats harbour a sparse population, chiefly Haigas and their dependents. The local demand for timber is consequently limited and is met by generously administered forest permit rules The best known timbers are yielded by Vitex altissima, Calophyllum tomentosum (Poon spar), Artocarpus hirsuta, Shorea Talura, Dysoxylum glandulosum, Chickrassia tabularis, Cedrela Toona, Eugenia utilis, and Diospyros assimilis (ebony), the latter mostly of small size. Principally owing to difficulties of transport and want of accommodation for travellers this region has been rarely visited by botanists.

(*To be continued.*)

BRUSHWOOD BURNING IN THE CHANGA MANGA PLANTATION.

BY ATMA RAM, EXTRA ASSISTANT CONSERVATOR

This operation is done annually in the coupe of the year. After the fellings are over at the end of March the brushwood, comprising small branches and twigs of the trees felled, is cleared off 40 feet from the firewood stacks and 5 feet round the standards and thrown inside the coupe compartments and set fire to, under the supervision of the Divisional and Range Officers. This clearing of the brushwood from the sites of the stacks and round the standards generally takes about three weeks. The firing is done and finished in the last week of April. As soon as this operation is completed

in any one compartment water (the plantation is an irrigated one) is let in to soak the ground for retrenching and refreshing the stools and standards. The retrenching in the burnt compartments is commenced and finished in May, the proper irrigation following the retrenching. Blanks caused by excess burning or already existing are sown direct with sissu seed. The irrigation and sowings are generally finished by the end of June. Then tending follows. In August-September the *improvement of* the coppice is carried out, noxious grasses, weeds and shrubs being cut down, and the mulberry, the formidable enemy of sissu, is cut back where suppressing the sissu coppice. This is the briefest account of the brushwood burning in the coupes. But the question naturally arises whether the process is based on sylvicultural reasons or others more weighty. I would invite opinions upon the following contrast :-

Reasons for burning brushwood :-

(1) There is no sale of the faggot wood; people will not remove it even gratis.

(2) (*a*) The brushwood hinders retrenching and consequently irrigation.

(*b*) The trenching out facilitates the growth of root-suckers.

(3) Checks, suppresses, or interferes with the growth of coppice shoots coming under or in contact with it.

(4) Interferes with the sowing operations in blanks.

(5) Renders difficult the improvement work of the coppice.

(6) Tends to restock the area by artificial means by reason of clearing the ground.

Reasons against burning brushwood :-

(1) (*a*) Deprives the soil of its natural manure; artificial manuring is never done and cannot be done in such extensive areas; the soil becomes too poor in the second rotation to produce strong shoots.

(*b*) The soil gets burnt to a considerable depth along with its useful elements of organic and inorganic matters.

(2) (*a*) Retrenching is not very necessary, irrigation being done by flushing the ground. It can best be done by making narrow "bands" along the width of the compartments at convenient lengths according to the level of the ground.

(7) Harbours certain species of insects injurious to forest growth. These bands can always serve as irrigation levels in the compartments.

(2) Root-suckers always appear when the vigour of the parent stools dies through fire, though they are much helped by digging the soil in trenches; but it is not advisable to make the forest too dense to produce thick wood which is here required

(3) Though the brushwood may interfere with coppice shoots for some time, if the irrigation is successful it must soon decay and they would get over any damage done

The large amount of money which is spent in burning and retrenching can best be utilised, in part, in disengaging the coppice shoots where interfered with by brushwood.

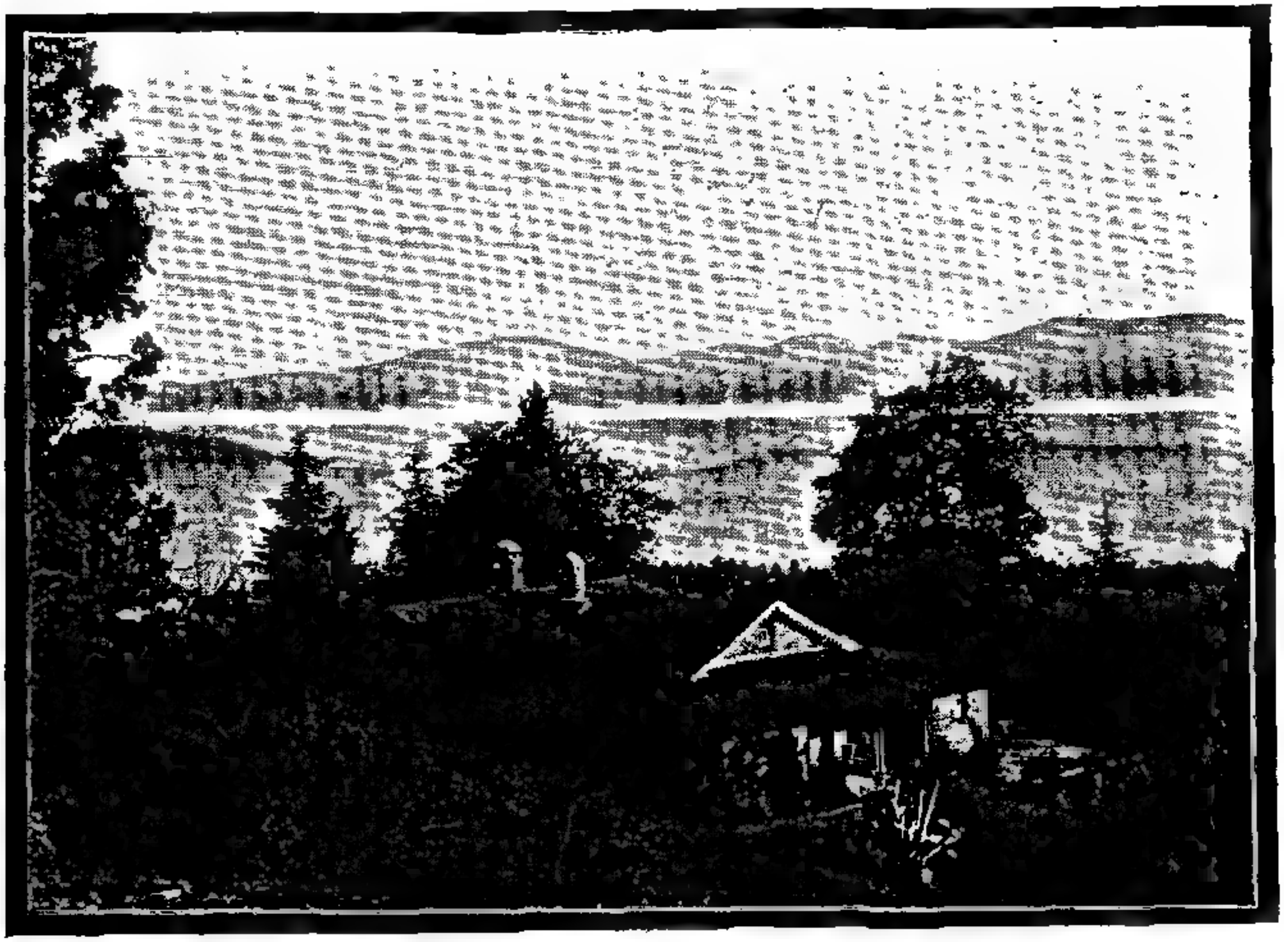
(4) The already existing blanks must show themselves when coppice shoots appear, and they can be restocked in convenient rpaces by planting out.

(5) The cutting back of mulberry, noxious weeds and shrubs suppressing the sissu will be rather a difficult task, but it is only a matter of money which can be saved under burning and trenching, and utilised here, in part, in addition to the original item. The rate per acre of improvement work may be doubled.

(6) The aim has been to fully stock the area without taking steps to thin out afterwards; the result has been the production of thin wood and consequently loss in money return. It may be advantageous if trees grow at convenient distances to produce thick wood and to dispense with the necessity of thinnings which are surely required in thick coppice forest.

As the demand for sissu and mulberry timber is growing, there is no reason why good thick stems should not be produced; the forest should never be allowed to become too dense so as to avoid the severe natural struggle for existence. It has an advantage of cleaning the boles but never of producing thick strong stems.

(7) If faggot wood lying on the ground results in attacks of insect pests, the fire causes death or severe injury to valuable trees and stools and *ultimately gives growth to various species of fungi.*



Chaubattia Forest Rest House, N. W. Himalayas.

Photo-Mechl. Dept., Thomason College Roorkee. Photo. by R. C. Milward.

This is how it happens. The huge fire burnt in the compartments penetrates the soil more or less according to the amount of brushwood lying on it and sends up flames high or low accordingly. The penetration causes death or severe injury to many a stool and the flames affect the standards according to the degree of their nearness to the fire. Many a stool comes into direct contact with the fire and gets cooked or baked. With the irrigation the fungi begin to grow on the dying or dead roots of the injured stools and trees, the spores having been brought by water or wind. The most common of them are the hard flowered fungus and the white-blight mycelium.* The former appearing at the base and the latter at the stem and thus *developing spread spores all round.* No amount of grubbing out of the affected roots or stems can extirpate them. Besides the above reasons there are several more against the burning, such as—(8) cost of burning; (9) cost of retrenching; (10) injury to some of the valuable standards unavoidable, (11) injury to some valuable young stools; (12) growth of fungi on the injured or *dying stock; (13) loss of beneficial moisture;* (14) luxuriant growth of weeds; (15) loss of some game birds.

TYPES OF FOREST REST HOUSES IN INDIA.

BY THE HONORARY EDITOR.

We have been greatly struck during tours through India on the great disparity which exists both in the type and in the varying degree of comfort of the buildings erected by the Department as rest houses for the controlling staff for use during the extensive touring forest work entails. Whilst fully recognising the fact that the nature of the building erected must depend to a great extent on the climate it has to contend with and on the materials available, it is at the same time an almost universal rule that the worse the climate the staff has to withstand the poorer the accommodation provided for it. The Local Administration of the United Provinces, although their Forest Officers enjoy a comparatively equable and cool climate, have

* Specimens of these fungi have been sent to Dr. Butler, who will, we trust shortly give us an account of them.—HON. ED.

taken the lead in this matter; they have thoroughly recognised the cardinal principle that on the state of a man's health will depend the quality of his work and that shattered health in their senior officers saps the very life from a Service. With a view to obtaining an amelioration in the type of bungalows or rest houses existing in other Provinces, we would ask our readers to forward photographs depicting the present types of rest-house in use in their circles with notes on their advantages or disadvantages.

We reproduce in this number examples of types of forest rest houses representative of those commonly found in the divisions of the United Provinces. Our acknowledgments are due to Mr. R. C. Milward, I.F.S., for the excellence of the photographs depicted.

We are indebted to Mr. Hobart-Hampden, Director, Imperial Forest School, for the following information on the bungalows we have chosen for illustration.

The rest-house shown in Plates V and VI is Chaubattia standing at something like 7,000 feet up in the N. W. Himalayas, looking over the Ranikhet Chir (*Pinus longifolia*) forest away to the snows, with the Tresul right in front—a grand view. Around it is the famous Chaubattia fruit garden planted by Government with the object of inducing the people of Kumaun to grow orchards of European fruit which is very well adapted to these hills. The house is of stone and mud mortar lime pointed and has an iron sheeting roof. There are three rooms besides bath-room, godown, &c.

Plate VII depicts the Lachiwala rest-house situated in the Dun eleven miles from Dehra and in the vicinity of several different working circles and a plantation of Bambusa burmanica. This plantation, just as it had become valuable and was beginning to demonstrate how superior this bamboo is to the indigenous Dendrocalamus strictus, was clean cut back like so much of the forest by the phenomenal frost of 1905. It is, however, already recovering.

The bungalow has a good plinth, *kutcha pacca* walls, thatch roof and fire-places in the rooms. There are three of the latter

Forest Rest House at Lachiwala, Dehra Dun Division.

Photo Mechl. Dept., Thomason College, Roorkee. Photo. by R. C. Milward.

with dressing-rooms, bath rooms, and godown. This bungalow is a good sample of many of the Dun rest houses.

In Plate IX is shown the Dudwa forest rest house situated in the centre of the Kheri Division in Oudh. It is in the middle of fine sal forest and from it no less than seven lines or roads (two of which branch almost immediately) radiate through the heart of the forest. The house is of brick with tiled roof and tile or brick floors and sal beams. This type of bungalow was invented by Captain Wood when Conservator in Oudh and was called class I. In this pattern there are two high upstairs rooms with a verandah running all round, whilst downstairs there are two ordinary rooms, two long dressing-rooms, two bath-rooms and one godown. The staircase is of brick and there are small verandahs in front and behind. Dudwa has, we understand, been rendered more useful by adding another room and bath-room upstairs, with some further additions below. These houses are extremely *pacca*, but the downstairs rooms are a trifle too low.

A CURE FOR WHITE LEPROSY.

B. K. BANERJEE.

Psoralea corylifolia, Linn. (*Babchi, babachi, bukchi, &c.*), is an herbaceous weed, the seed of which is said to be used for scenting hair oil and for other minor purposes.

But the most important use of it—a cure for leucoderma (white leprosy)—has been made mention of by several authors, but without the exact process of preparation being given.

The late Dr. Kanai Lall in his "Indigenous Drugs of India" strongly recommended the oleoresinous extract of the seed for leucoderma, but the authors of the Pharmacographia Indica state that only negative results were obtained in later experiments with it.

I believe Dr. Kanai Lall to have been correct in his recommendation so far as the seed of *Psoralea corylifolia* was concerned, but only the adjuncts and processes of preparation were wanting.

I was told of a well-tried and infallible cure for this disease known to the *members of a noble family in* Bengal. It is said that the recipe of the remedy was originally obtained from a hermit or *sanyashi* by some one of that family.

I cannot understand what prevented them from making it known to the public for the good of the unfortunate victims to this dreadful disease.

I am glad to say that after all I have been successful in getting the exact process of its preparation, the want of which, I believe, has up to date stood in the way of successful experiments. Now I wish it to be made known to the public for verification and appreciation of its merit.

The seed of *Psoralea corylifolia* is the principal ingredient of the remedy, and the process of preparation is as given below in full :—

The seed is first powdered finely and thereafter the powder is pasted in cow-urine sometimes in combination with a few fresh leaves of *Eclipta alba* (Vern. names *mochkand, bhangra, babri* Hind.), *kesuti, keysuria* &c., (Beng.)—a herbaceous weed of the Natural Order Compositae. Admixture of water is to be strictly avoided. In order to avoid any mixture of impurity and dust the cow-urine should be caught, when being passed, in a stone or glass pot (never in a metallic one).

The paste thus prepared should be applied thinly over the white patch twice or thrice a day. The paste sticks very firmly to the patch, and should be applied one layer over another until the accumulated layers of paste come off of themselves taking with them a thin layer of skin from the diseased part.

The application of the paste is to be continued as before, and the occasional peeling off of the accumulated layer of paste together with a thin layer of skin should be allowed. Gradually some very small and scattered spots, other than pure white in colour, will be visible, and the application of the medicine having been continued regularly, the said small and scattered spots will almost imperceptibly develop and ultimately turn the whole white patch into the natural colour of the skin.

It is said that leucoderma of the purest white type takes a longer period to cure than the reddish one. The patient should take good and nourishing diet.

SHIKAR, TRAVEL AND NATURAL HISTORY NOTES.

ON THE OCCURRENCE OF ELEPHAS ANTIQUUS (NAMADICUS) IN THE GODAVARI ALLUVIUM.

The following are extracts from an important paper by Mr. G. E. Pilgrim, B. Sc., of the Geological Survey, upon the discovery of a skull of *Elephas antiquus (Namadicus)* in the Godavari alluvium which appeared in the Records.

In February of last year, Mr. H. F. G. Beale, of the Public Works Department, informed the Geological Survey of the discovery of fossil bones at Nandur Madmeshwar (Lat. 20° 1'; Long. 74° 11') which I was at once deputed to excavate. The locality is on the Godavari river and is about eight miles south of Niphad station on the G. I. P. Railway in the Nasik district of the Bombay Presidency.

Great interest must attach to any discovery of fossil bones in the Godavari alluvium, as so few records of such exist. As compared with the alluvial deposits of the Narbada, which flows in a contrary direction, and enters the sea on the west coast of India, our knowledge of those of the Godavari is very limited, both as regards the fossil contents, and even as to the nature, thickness and

superficial extent of the alluvium itself. It may not therefore be out of place to touch upon these points in the course of this paper as tending to throw some light upon the origin both of the Godavari and of the Narbada deposits.

That the fossil fauna of the Godavari beds is no less rich than that of other Indian river deposits is proved by the reports we have in the past of exceptionally large "finds" of bones in them In but few cases, however, has any trouble been taken to preserve the bones or turn the discovery to scientific account. At some time during the fifties, an elephant skull was found in the Godavari valley. No account of the discovery seems to have been published, and, so far as I know, the only authentic record of it is contained in a manuscript note by the late General Twemlow, the original discoverer. To this Dr. W. T. Blanford had access when he wrote his note on the Godavari gravels.* He considers that it is the same as that referred to by Dr. Falconer in a paper read before the Geological Society of London,† when he mentioned the occurrence of *Elephas namadicus* "in richly fossiliferous fluviatile deposits of Southern India" Major-General Twemlow also seems to have been under the impression that the skull in question was examined and named by Dr. Falconer. We may therefore conclude that this Godavari elephant was identified by Falconer as *Elephas namadicus*, Falc. and Cautl. It was obtained near Paitan, a town on the Upper Godavari, south of Aurangabad (19°45'; 75 30'), on the left bank of the river, and had been washed out of a calcareous conglomerate, of which the bank consisted. The skull was sent to Sir *Philip Egerton in England, but I have* no knowledge of what eventually became of it. It appears to have been of immense size, as the tusk is said to have been 29 inches in circumference. The tusk of the animal which forms the subject of the present paper measures 25 inches in circumference at the base.

Since 1867 no collections were made from these interesting deposits until February 1904. I shall therefore proceed to the details relating to this latest fossil find.

* Mem. Geol. Sur. Ind., VI., p. 232.

† Q. J. G. S., XXI, p. 381; Falconer . . Mem., II, p. 463.

Lith. and Printed at the Geol. Surv. Office, Calcutta

ELEPHAS ANTIQUUS (NAMADICUS

In the area which I was able to examine, most of the alluvial deposit lies on the left bank of the Godavari. The alluvial cliffs rise to a height of about 60 feet above the general level of the river-bed and are highest at a point about one mile further up the river than Nandur Madmeshwar. It was here that I found, embedded in the gravels, in the very channel of the river, a magnificent skull of the ordinary Narbada elephant. These cliffs consist of conglomerates, gravels, and clays quite devoid of any stratification and showing evidences of a continuous period of deposition, marked only by such changes in the character of the deposit as might be expected in the history of most rivers. Calcareous concretions (kankar) were not observed in any portion of the deposit. The river-bed here was perhaps a quarter of a mile wide, but at the time of my visit most of it was entirely dry and the flow was kept up only in two or three channels. The broadest of these occupies the extreme right-hand margin of the river-bed. The falls are not more than 15 feet high, and are entirely of the Deccan Trap. In fact all the rock within sight here is of the same nature, as is also the greater portion of the dry bed of the river. To the right of the river just here there seems to be hardly any trace of alluvium, although lower down, opposite Nandur Madmeshwar, the right bank is alluvial. On the left of the river, however, the alluvial deposit stretches away some distance, but has been deeply carved out into innumerable small gullies showing to what an extent the forces of denudation have been acting. It would seem as if this alluvial deposit were confined to the immediate neighbourhood of the Godavari or of its main tributaries, one of which, the Kadva, I followed from the railway. At various places near its banks the same network of deep channels had been cut out of the soft alluvial gravels, the existence of which I have noted on the Godavari. The smaller tributaries, however, had cut down into the Deccan Trap, and in many cases their sides consisted only of trap and soil arising from disintegration of trap. One is therefore led to the conclusion that the alluvium, though distributed over a wide area and accumulated locally to a considerable thickness, does not persist equally, and, except in the

immediate neighbourhood of the depositing streams, is either superficial or altogether absent. It seems highly probable, however, that the alluvium of the Godavari valley as a whole, even if it be only superficial, is sufficient to merit a recognition on the geological map as distinct as that which has been accorded to the more northern rivers.

Immediately at the foot of the alluvial cliff above mentioned, the river flowed in three small adjacent channels in one of which were the fossil remains. These channels were separated from one another by a hard, calcareous, gravelly conglomerate, which, next to the bones, had become cemented into a refractory concrete material inseparable from the bone. The skull was almost entirely covered by water about three feet deep. On account of the alteration in the general level of the water being but slight for a considerable distance, it proved difficult to lower it at the required place, while the porous nature of the rock prevented the dams from being very effective. I supplemented the dams, however, by keeping a large gang of coolies continually baling, and in this way I was able to dry the spot sufficiently to extract all the fossil bones embedded there.

Throughout the operations I was much indebted to Mr. A. Hill, C.I.E., Executive Engineer at Nasik, for the assistance and implements which he kindly placed at my disposal.

The position of the animal, as found, was facing upstream. The cranium was resting on the vertical portion of its occiput, while the inferior part must have been subjected to the erosive action of the river for several years. Under these circumstances its imperfections are not surprising. A portion of a tusk lay detached a few feet in front of the cranium. Closely cemented to the cranium was the distal end of the femur, the head of the bone having evidently been jammed by some projecting part of the skull. About 4 feet behind the cranium, the pelvic bones were found. Through the kindness of Mr. H. M. Phipson, the Honorary Secretary of the Bombay Natural History Society, the proximal end of the femur and another portion of a tusk have been placed in our possession. Both of these had previously been obtained

from the same spot by Mr. Beale and sent by him to Bombay. The whole of the remains are now deposited in the Geological Museum at Calcutta where the skull has been reconstructed and set up. That all of these belonged to a single individual no reasonable doubt can be entertained.

In the gravels near the same spot was found a portion of the lower jaw of a Hippopotamus containing the incisor and canine teeth. This specimen is unfortunately missing,* but there is little doubt that it belonged to the subgenus *Tetraprotodon* and may be assigned to the species *H. palaeindicus*, Falc. et Cautl. A single tooth has been identified as that of *Equus namadicus*, Falc. et Cautl. Crocodile teeth were also found, and several shells of Mollusca which are identical with those that exist in the area at the present day.

The cranium and bones, which I am describing, and which represent the species *Elephas antiquus* (*namadicus*) Falc. et Cautl. belonged to an individual of remarkable size. It cannot have stood much less than 16 feet at the shoulder. The cranium, as found, is larger than any hitherto recorded. Individual bones have, however, been found both in India and in Europe, the original owners of which must have attained an equal or even a greater stature. The validity of the name *Elephas antiquus*, as applied to the Narbada elephant, will be referred to later. It will be more convenient to describe first the portions of the animal which the present find has put into our possession.

The cranium.—The cranium either on one or both sides possesses all the essential features of the portion above the maxillaries and the foramen magnum. The occiput on the right side is complete, with the exception of a small region lying between the posterior depression and the vertical boss. On the left side this region is retained, but, on the other hand, the whole occiput external to the left vertical boss is broken away, together with portions of the parietal and frontal

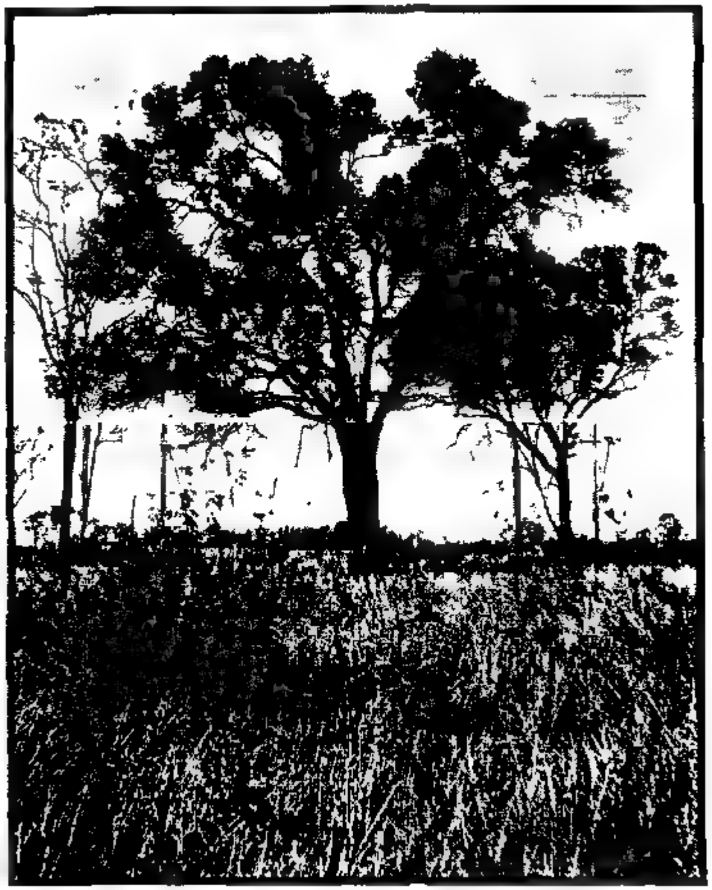
* It was stolen during the night from my collection of specimens at Nardur Madmeshwar, presumably by a villager, and subsequent enquiries failed to elicit any information with regard to it

and the upper part of the temporal. The foramen magnum and the occipital condyles are missing. The frontal region and nasals are perfect. The incisives are only partially preserved. It will, however, be observed that sufficient of them has been left bordering the nasal fossa, as well as in the distal region, to determine their shape and dimensions. The portions of the temporal fossa below the level of the external auditory meatus are broken away; on the left side the auditory opening cannot be observed, but on the right its position is distinctly indicated. The base of the zygomatic process of the temporal is preserved on the right side, and on both sides the orbit with the supra-orbital and post-orbital processes are well shown. The cranium, like all the bones, was surrounded by a very hard unyielding calcareous conglomerate in removing which the bones have lost some substance.

The accompanying plate, Plate VIII, exhibits some of the more important characters of the present cranium, and the most casual inspection of it can leave no doubt as to its identity with the crania from the Narbada beds figured by Falconer in the *Antiqua Fauna Sivalensis*, Plates 12A, 12B, Figs. 1 3 and Plate 24A, Figs. 4 4A, as *Elephas namadicus*. These are the two most complete crania which have been known up to now, and are preserved in the British Museum. One of them has small tusks and probably belonged to an adult female. The tusk sheaths are broken off almost immediately in front of the nasal foramen. The other, that of a young male, has large tusks, and shows also the characteristic divergence of the incisive alveoli. Five other crania exist in the Geological Museum at Calcutta. These are all exceedingly imperfect. Two of them, however, show the supra-orbital ridge, which, until Pohlig's extensive discoveries of *E. melitensis*, Falc. in the Grotto di Pontale von Carini in Sicily* had been considered peculiar to the Indian species, if indeed there were not still some Palæontologists left who favoured Professor Leith Adam's surmise that this peculiar frontal projection was a deformity or a distortion produced by compression after death. The present skull is that of a fully grown male. Plate VIII shows

* Abh. d.k. Baye. Akad., XVIII, p. 75.

a side view of the skull which is here reproduced through the courtesy and with the permission of Mr. T. H. Holland, F. R. S., Director of the Geological Survey. It appeared as Plate XII in the Records from which these extracts are made.



OLEA CHRYSOPHILLA

JUNIPER FOREST.

Photo-Mech., Dept., Thomason College, Roorkee.

Photo By [illegible]

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PROVINCIAL FOREST TRAINING SCHOOLS.

How to educate the lower grades of the Provincial staff in forest business is a question which must often have presented itself both to the Conservator of the Circle and to the officer in charge of the forest division. It is a matter which has yearly been acquiring a greater degree of importance until to-day, in most parts of the country, it faces the department as probably one of the most urgent problems requiring solution. In the early days of forest conservancy the services of the Forest Guard, to go to the lowest rung, were required as much as a guide in, as a guardian of, the forests. The superior officers were occupied in ascertaining what the forests contained, their extent in demarcating new reserves and in removing timber from accessible areas for railway purposes - in all of which operations the educational knowledge required from the lower subordinates was not excessive. The question of educating the upper ranks of the Provincial service—the Ranger quickly forced its way to the front and the Dehra School was founded with this purpose in view. The School

has produced the present Extra-Deputy, Extra-Assistant, the Ranger and Deputy Ranger. We trust in a subsequent article to deal with the training given at the Dehra institution. For a time the assistance given by the Dehra Dun trained Ranger and Deputy Ranger afforded considerable relief to the Divisional Officer. The stage had not yet been reached when forest education of some sort was essential throughout the ranks of the department. Reservation and demarcation progressed hand in hand with the amelioration of the forests up to a point when it became possible to bring them under working plans. Scattered throughout the continent there now exist numberless demarcated tracts worked under well-thought-out plans, requiring a highly technical staff to ensure that every provision and prescription laid down shall be carried out in so far as is humanly possible. The untrained officer in the Provincial service is no longer of any use. From highest to lowest some training is required and the instruction must be given, of course, in proportion to the intellectual attainments of the class it is possible to recruit The Forest Guard, and the Forester immediately above him, can no longer, if they are to be of any real use, remain the uneducated jungly inhabitants of the forest tracts in which they have been reared. So far as is possible they are still the men required for the posts, but it has become essential that they should be given in some manner a certain amount of training in the work required from them.

The point we wish to consider in this article is how should this training be imparted and to what extent is it required ?

Last year we reproduced in this Journal* proposals under consideration in Madras for a training school in that Presidency. The suggestions made by the Board after consultation with the Conservators were that a training school for Foresters and Guards should be instituted in each Circle, and that a three months' course in the vernacular, confined to practical field work, be given. These proposals were not accepted in their entirety by the Madras Government, and in one cardinal point they radically modified the suggestions. The training of the Forest Guard was

* Volume XXXI, p. 285

cut out altogether. They sanctioned the formation of a training school for Deputy Rangers and Foresters already in the department, who had not had the benefit of training in the Forest School at Dehra nor were likely to be deputed there; the school to be also open to candidates for the appointments at their own expense. The course was to be a six months' one, two separate courses being thus undertaken in the year, the students in each term not exceeding 30. The instruction was to be given by an Extra-Assistant Conservator assisted by a Ranger, the direct control of the school being under the Conservator. The subjects to be taught were laid down as elementary surveying, demarcation, fire-protection, supervision and execution of works, elementary principles of sylviculture, mensuration, gymnasium. This school was inaugurated on the 1st April last and has been in existence nearly a year.

The formation of this school has shown that the Madras Government are fully alive to the great necessity of training the subordinate staff, and we have little doubt that the case of the Guard will in itself receive attention at a not distant period.

Turning now to India we find that the Guard and Forester are entirely uneducated in forest matters, and for the most part the greater number of the Deputy Rangers are in the same position. In other words, in a great part of the country highly-trained officers are endeavouring to carry on technical and complicated work by means of entirely unskilled labour, the results being detrimental to the forests themselves, to progress and to continuity of policy.

We would ask whether it is not possible to at once start about remedying this state of affairs, and our recommendations, we think, will not involve any large outlay whilst at the same time adding a hundred per cent to the value of the subordinate ranks—the Deputy Rangers Foresters and Guards who have had no chance of a technical training but who would greatly profit by it in their executive work. We will consider how this can be done.

Some years ago, owing to the wise foresight of the N.-W. P. and Oudh Government of the period, there came into existence what was known as "Oudh leave" under which Forest Officers

in those favoured Provinces were allowed to proceed to the summer headquarters of the Local Government (Naini Tal) at their own expense for a period of two months during the recess, thereby recruiting their health whilst getting into touch with the higher officials of the Province and with other members of the Department. Probably no wiser or more benevolent policy was ever inaugurated than this concession, and we are glad to note that it is now being freely extended in other Provinces; for, in addition to the United Provinces, officers in Bengal, Assam and Burma have had the privilege extended to them. We see in this valuable concession a means of carrying out our proposals for the education of the subordinate grades. We would suggest that during the recess in the hills a class should be formed to last over a period of about four months. To this class would be deputed the intelligent Deputy Rangers, Foresters and Forest Guards, the course being conducted by an Imperial Officer. The instruction would be confined entirely to the practical side of Forestry and would, as far as practicable, only deal with the species of trees, &c., with which the men would have to deal in future. We would suggest that the course comprise a few lectures upon the life history of the tree and its requirements, aided wherever possible by sketches and drawings on the black board. The lecturer would then deal with the effects it is intended to obtain by various forest operations and the disasters which result if these are not properly carried out. The protection of the forest should take a prominent position in the course. Elementary demonstrations of the effects of fire, grazing and injuries by men, animals and insects would be given. Protection would be followed by a short course on methods of utilisation, the proper manner to fell, methods of extraction, &c., the course being concluded with some notes on forest engineering, the main principles of kutcha road making, the building of simple bridges, &c., being described. The keynote of the whole instruction, which should be rigorously insisted upon, would be simplicity; the whole course would be a purely practical one, scientific language, nomenclature, formulæ and symbols being rigidly excluded. In recording their notes during the lectures the students should

be made to copy down the figures drawn upon the black board and an endeavour should be made to see that they have some elementary ideas of how to draw out freehand a rough plan of a simple bungalow or bridge.

We have said that the course should be conducted by an Imperial Officer, and we would suggest that in addition a Provincial Officer be attached to act generally as tutor to the students, inspect their note books and see that they are written up, &c. The only qualification which would be required of the student would be sufficient literary attainments to enable him to follow the prescribed instruction, which would, of course, be in the vernacular. Most Divisional Officers (and probably every Conservator) are aware of the fact that there are numbers of excellent, keen, hardworking men amongst the subordinate ranks who would profit generally by adding a little knowledge of the above kind to the practical experience they already possess and the value of the trained article to Government would be incalculable.

As will be seen our proposals, whilst they will usefully occupy the time of the subordinates during the recess and result in immensely increasing the efficiency of the lower Provincial staff, will cost practically nothing. A small allowance or travelling allowance to the Provincial Officer deputed and railway fares and travelling allowances to the students will not prove heavy items, and we feel sure that the Divisional Officers would welcome the formation of such a school with alacrity.

In drawing the attention of Local Administrations to these proposals, we would earnestly ask for their co-operation in the department's aim at efficiency, and nothing but efficiency, throughout all ranks.

SCIENTIFIC PAPERS.

ON THE LIFE HISTORY OF TERMES (COPTOTERMES) GESTROI, WASM. THE HEVEA RUBBER TERMITE.

BY E. P. STEBBING.

For some years past it has been known that the rubber plant (Hevea braziliensis) in the Malay Archipelago has been subject to the attacks of a species of termite known as Termes (Coptotermes) Gestroi. This insect had been reported from Borneo and Singapore and also subsequently from the Straits Settlements. In 1898 the late G. D. Haviland wrote as follows upon this termite * :—"This species is remarkable for its habit of killing live trees. It encloses the trunk with a thick crust of earth; under cover of this crust it eats through weak spots in the tree to the heart of the wood."

In a note in the Agricultural Bulletin of the Straits and Federated Malay States H. N. Ridley, the Editor, mentions that Para rubber trees when growing in grass appear to suffer just the same from the attacks of this pest. In a subsequent issue † R. Pears corroborates this statement and says that the same is the case when the trees are growing in "lalang." Neither the grass nor the "lalang" appear to form any hindrance to them "as they carry on their labours as vigorously as ever, destroying several adjacent trees as they would do if the ground were clear." From the observations detailed below the reason for this behaviour will appear. Since the insects work beneath the ground the presence or absence of vegetations round the trees can have little effect upon their operations.

In May of last year I received a communication from Mr. F. B. Manson, at the time Conservator of Forests in Tenasserim, informing me that he had received a report from the Manager

* Journal Linn. Soc., Lond., Zoology, Vol. XXVI, p. 391 (1898), December 1904.

† February 1905, p. 78

of the Mergui Rubber Plantation (Mr. J. W. Ryan) stating the trees were being attacked by species of termites. A copy of this report, to which I shall allude later, was sent to me together with three different specimens of the termites committing the damage.

Two of these have now been identified by M. Desneux, the well-known authority on the Termitidæ, as Termes Gestroi and a species of Termes closely allied to T. annamensis, Desn., which had previously been reported from Annam. No identification of the remaining specimens sent has yet been found possible owing to workers only having been received.

We will consider these insects in detail.

TERMES GESTROI.

The *workers* are elongate, pale yellowish white insects with the head small, pale; the first thoracic segment enlarged and broader than the two following. The body is oval, broader than the meso, and metathorax and bluntly pointed posteriorly. Length ¼th inch.

The *soldier* is smaller than the worker. The mandibles black, prominent and crossed over one another. First thoracic segment enlarged and orange in colour; rest of insect yellower than in worker; legs more elongate and powerful. Length 1/5th inch.

According to Mr. Ryan this termite attacks the tree at the crown of the root and eats its way upwards, hollowing out the trunk. Since the white ants commence their work well below the ground, there is no indication of their presenee until the trees begin to show signs of withering. The damage has then gone too far for it to be possible to save the attacked tree. The branches begin to die and drop and the tree itself falls in the first strong breeze.

It would appear that Termes Gestroi attacks the tree for the purpose of obtaining the rubber from it, for, on applying pressure to the bodies of the termites, it was found that the majority of them were full of fresh latex. They apparently collect and store the

rubber, masses of rubber being found as a rule in the nests, which are usually situated at the crown of the root. From one of these nests situated at the base of a three-foot girth tree as much as 2 lbs. of rubber was collected.

An examination of the crown portion of the root of a tree shows that the main direction of the galleries made by the termite is horizontal, *i.e.*, parallel with the long axis. These galleries are of considerable size, ramifying a great deal, have smooth sides, and are connected here and there by holes or short galleries eaten out in a vertical direction. The galleries practically form an intricate mass of chambers which are kept quite free of earth and some of which are evidently stored with a certain amount of rubber. In the specimen of the root I have examined, it is apparent that the work of the termite is entirely confined to the crown of the root, none of the tunnels extending upwards into the stem (in the present case stems, for there were two taking off from the root).

ADDITIONAL INSECTS PRESENT WITH TERMES GESTROI IN THE NEST.

In the tube containing the specimens of Termes Gestroi I found grubs and pupæ of other insect forms present.

1. At least two different kinds of Heterocerous larvæ were present, both probably noctuids.

2. Immature pupæ of a species of coleoptera, perhaps a coccinellid (Coccinellidæ). The pupæ were, however, quite unknown to me.

The presence in the nest of these other forms of insect life is of very considerable importance. One or more of them may be predaceous upon the termites. It may be pointed out here that should such prove to be the case the knowledge would be of the very first importance in considering measures for combating the termite.

TERMES SP. PROX. ANNAMENSIS, DESN.

This Termes was taken from a nest situated in the ground in the plantation a few feet away from the rubber trees. It was

thought by the Manager to be identical with T. Gestroi. It is, however, a different species, and as far as is at present known causes no damage to the rubber trees.

TERMES (?) SP.

Only workers having been as yet procured of this species it is impossible to identify it at present. Mr. Ryan states that the insects build their galleries on the outside of the trunk and feed on the dead bark, thus following the usual procedure of *Termes taprobanes* in Sal forests. The Manager mentions that he has never found the insect to injure the rubber trees in any way, nor has he ever found any latex in their bodies. Since this insect is present in the plantations it will be of interest to have it identified. For this purpose the other members of the community are required. By tracing down the earth galleries on the bark of the tree to the base of the latter and turning up the earth all round it, it will be possible to obtain them and thus to have this point settled.

POINTS IN THE LIFE HISTORY OF T. GESTROI REQUIRING FURTHER OBSERVATION.

We at present know little about the life history of T. Gestroi, and since it appears more than probable that the termite is likely to prove a source of very considerable loss in rubber plantations, unless its action is thoroughly understood, it behoves those in charge of such areas to endeavour to do all in their power to procure all information possible upon its life history and methods of attack. The following are some of the points requiring further observations and elucidation.

1. The period of the year at which the termites are active and commit injury to the trees.

2. Is the rubber in the nest used as food by the termites?
   - (*a*) To feed the young larvæ.
   - (*b*) To serve as food during the period of inactivity, if there is one.

3. The origin of the nest. How is it first formed?

4. Where do the termites found in the nest in the crown of the root come from in the first instance?

5. Length of time which elapses from period of first attack to time the tree is seen to be dying.

6. Depth below the surface at which the termites work.

7. Proportion of active workers to non-workers in a community.

8. Do the insects always work in the dark?

9. Is it possible to reach the nest without killing the tree?

10. The position occupied by the king and queen termites in the nest.

11. Are there any subsidiary galleries radiating from the central nest to other parts of the plantation, either above or below ground? If so, where do these go?

12. Is the nest connected in any way with adjacent ones in neighbouring trees.

13. The parts played by the heterocerous larvæ and the grub and beetle of the coleopterous pupa found in the nest.

These are some of the points which occur to me as requiring solution. Doubtless others will present themselves to Managers on the spot. Until we have answers to these questions from careful observations made on the spot, it is almost impossible to say what would be the best way of combating this extremely serious pest. So much money has been, and is being, put into rubber plantations in what may be termed the Indo Malayan region, which is evidently the home of Termes Gestroi, that it behoves us to take up this question of the study of its life history fully and without delay.

I shall be exceedingly obliged if readers of this note will kindly send me* all the information they can procure upon the insect at an early date.

* To Dehra Dun, United Provinces, India.

AN AFRICAN STREAM, THE RUERU.

Photo. Mecnl. Dept., Thomason College, Roorkee. Photo. by E. Battiscombe.

ORIGINAL ARTICLES.

FORESTRY IN THE EAST AFRICA PROTECTORATE.

BY E. BATTISCOMBE, ASSISTANT CONSERVATOR OF FORESTS.

It is only within the past five years that public attention has been drawn to the East Africa Protectorate, and even now many people have a vague sort of idea that it is only another name for Uganda.

Roughly speaking the Protectorate may be said to be that portion of Africa, bounded by the Indian Ocean lying to the north of German East Africa, to the east of Lake Victoria Nyanza and extending as far north as Abyssinia and Somaliland.

A very good idea of the conformation of the country may be obtained by following the line of the Uganda Railway from the Coast at Mombassa to Lake Victoria at Port Florence. Leaving Mombassa the line commences to rise at once and continues to ascend steadily till it reaches the summit of the Kikuyu Escarpment overlooking the great Rift Valley, which extends from the Red Sea to the Zambesi River. Maseras, 16 miles from Mombassa, is 530 feet above sea level, Voi, 103 miles, is 1,830 feet, and Nairobi the metroplis, 320 miles, has an altitude of 5,450 feet and the summit of the Escarpment 358 miles, 7,900 feet. Having climbed thus far the line descends into the Rift Valley which it crosses, Elementeita in the valley being 5,890 feet in altitude, and then commences to ascend the Mau Escarpment, whose summit is over 8,320 feet; the line then commences its descent to the Lake, Port Florence being 3,650 feet above sea level at Mombassa and distant from that place 584 miles.

In March 1902 Mr Elliott, late Conservator of Forests in the Punjab, was appointed Conservator of Forests of those forests immediately adjoining the Railway; his appointment being

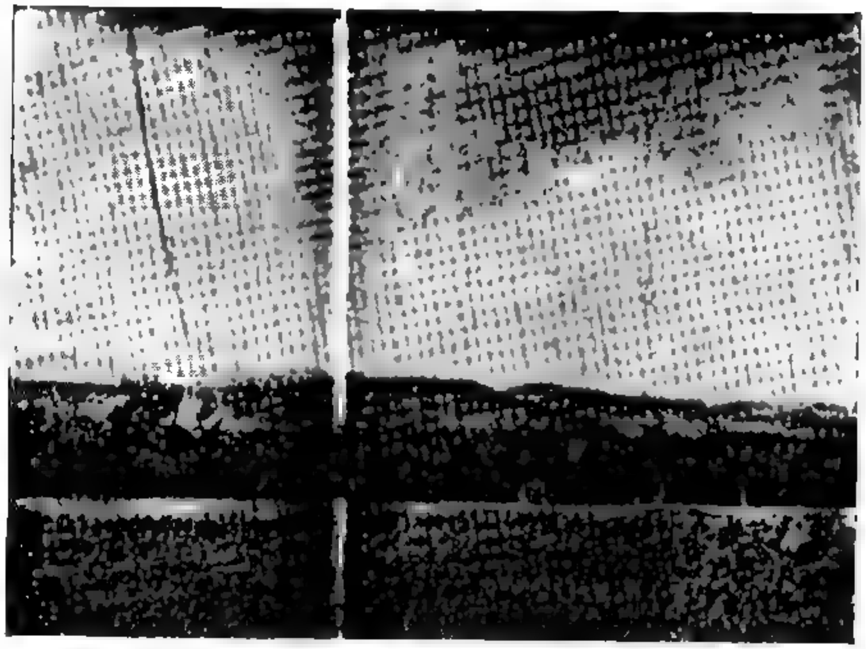
subsequently altered to that of Conservator of Forests for the whole Protectorate. His task was a large one; for two years he had no trained men to assist him, but during his term of office, which unfortunately terminated last April, he managed to reach all the most important tracts of forest and had them gazetted as forest areas. This was most important as settlers were pouring into the country and taking up land as near to the Railway as possible and naturally without any consideration for forest preservation. Already the area under forest is small, and every acre is needed in order to maintain the water supply of the country, so that the result might well have been calamitous had the settlers been allowed to work their will on the forests. It is not the settlers, however, who do damage but the natives of the country who destroy the forests by burning, felling and grazing their goats and cattle in all directions. This trait in their character is not perhaps altogether peculiar to the natives of East Africa.

At present it is the chief object of the Forest Department to put a stop to all further encroachments by the natives, to properly define the boundaries of the forests, and to find out what amount of timber there is available for extraction, as there is a rising demand for timber for building and other purposes.

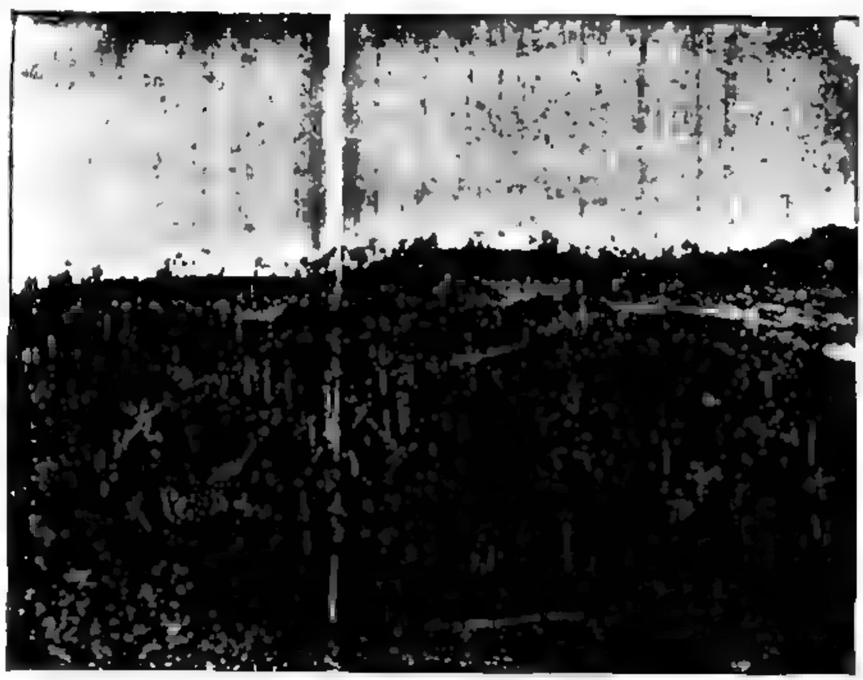
The Forest Department is now under the management of the Director of Agriculture.

It is of the forest on the high lands, *e.g.*, from an altitude of 5,000 feet up to the tree limit, that the writer of this article wishes to give a short description.

Between altitudes of 5,000 feet and 6,000 feet the forests are very irregular appearing in patches of 1,000 to 5,000 acres, and are essentially composed of hard woods of no great size; in the majority of cases the conditions of forestry in these groups are excellent wherever the natives have not made an ingress; the boles of the trees being clean and straight, with but little undergrowth showing that the crowns of the trees form a complete canopy overhead. From 6,000 feet up to 7,500 feet, the forests are enormously varied, many hardwoods, also many quick growing species—all with very large leaves—which appear to be worthless



JUNIPER FOREST.



FOREST DESTROYED BY NATIVES, ALL RECENT.

Photo. Mechl. Dept., Thomason College, Roorkee. Photo. by E. Battiscombe.

either for fuel or construction purposes: Juniper J procera—begins to appear at an altitude of about 5,500 feet and gradually increases in quantity as one advances higher, and at about 7,000 feet Podocarpus—at present the most useful known timber in the country is found; both these two conifers flourish at an altitude of 8,000 to 8,500 feet, the former being found pure on dry wind swept hillsides, the latter preferring the deep soil of the broad leaved forests, but is never found pure. The tree limit is reached at about 8,500 feet, bamboos appearing at about 8 000 feet and flourishing up to 10,000 feet: these are succeeded by open moorland, covered with species of heath, the flora being typically alpine.

Of the species of trees composing these forests unfortunately at present but little is known, some few have been named. Juniper and Olive are the only two species which form pure forests, all other species growing in mixed forests.

The following orders are largely represented—Oleaceæ, Tiliuceæ, Rubiaceæ, Rutacea Apocynaceæ, Malvaceæ, Compositæ (one large tree, wood hard and light, native name Muhugu), Leguminosæ. The conifers are represented by Juniperus procera, Podocarpus milanjianus and P. elongata. Waddringtonia is not indigenous.

Rubber is to be found nearly all over the Protectorate; it is chiefly derived from species of Landolphia, L. Kirkii being the most sought after for commercial purposes. The chief rubber districts are at the Coast, in the Kilimanjaro district, and near Lake Victoria Nyanza. It is found up to 7,500 feet on the Aberdare Range, also on the Mau.

In order to give some idea of the conditions prevailing in the forests near Nairobi a short description is given of a small block of forest of which the writer has recently made a rough working plan.

SITUATION

The Karura forest is situated about three miles north west of the town of Nairobi.

AREA.

The area of the forest is 2,590¾ acres. This includes much grass and scrub land. The actual area of forest is 2,102 acres, included in the remaining 488¼ acres is grass land, scrub and areas destroyed by fire but in which a few scattered living trees are still standing.

CONFIGURATION.

The forest stands on the edge of the Nairobi plain at an approximate altitude of 5,600 feet above sea-level at Mombassa. It is intersected by two rivers, the Ruaraka and the Karura; the Katisura stream forms the southern boundary for two miles; the banks of these rivers which flow in an easterly direction are fairly steep but nowhere precipitous. From west to east the forest extends 3¼ miles.

GEOLOGY AND FOREST SOIL.

The forest lies on the iron stone which is overlaid by red earth; wherever the trees have not been destroyed there is a good depth of humus. In many places the sub-soil is very shallow, and here and there the iron stone crops out.

CLIMATE.

The climate is dry and fairly equable, there being no great extremes of heat or cold. There are two wet seasons, from March to the end of May and again from the middle of October to December. The winds which are generally easterly are not dangerous. The average rainfall for the past five years has been 37·04 inches.

DANGERS

Fire is the chief danger to be guarded against. Heavy thunderstorms do a certain amount of danger by causing trees which have been completely enveloped by a species of fig to fall, and in their descent they break many other trees. Damage caused by lightning is to be seen occasionally.

The natives formerly committed a great amount of damage by destroying parts of the forest in order to cultivate; at present the

FOREST AT ALTITUDE OF 8000 FEET.

Species: Podocarpus milanjianus; Allophyllum abyssinicum. Pygeum africanum.

MUHUGU TREES, NAIROBI.

Photo.-Mechl. Dept., Thomason College, Roorkee.

Photo. by E. Battiscombe.

chief damage caused by them is the grazing of goats within the forests.

Damage by game is insignificant, Bush buck and Duyker eat young saplings, but not to any great extent. Much information still remains to be acquired concerning insect pests.

CROP.

The crop, consisting mainly of hardwoods, is enormously varied. With the exception of Mukurue (Albizzia ?), Makindari (Croton Elliotanus), Muhugu (Compositæ) and a few isolated specimens the trees do not attain to any large dimensions, rarely *exceeding 60 feet in height* or 3 feet *in* girth. The species are all fairly equally distributed over the whole area, Mukurue and Mukoyi (Albizzia) growing on the banks of streams only.

In order to obtain an idea of the amount of timber in the forest, three sample areas of ½ *acre each were taken and every* tree carefully measured with the following result per acre: Number of trees 350; volume 7,565 cubic feet. The following were the chief known species: Albizzia (?), Dolichandrone Hildebrandii, Croton Elliotanus, *Calodendron capense, Olea chrysophylla, Olea laurifolia*, Teclea unifoliata, Strychnos sp., Ochna sp., Bombeya sp., Randia sp., Acacia sp., Grewia sp.

As regards sport to be obtained in the forests there is very little; what shooting there is, is distinctly of the big game order as elephants are the chief denizens of the forest. There are a good number of Bush buck (Tragelaphus sylvaticus) in the woods bordering on grass land, they are very shy, and on account of the dense undergrowth very difficult to come up with. Water buck (Cobus ellipsiprymnus and C. defassa) frequent the edges of forests. Leopards are very plentiful, especially near the native cultivation where *there is always* plenty of food in the shape of monkeys. Rhino are sometimes found in the forest; they are excellent forest guards, as they are treated with great respect by most natives; they are, however, essentially animals of the plains. So much has already been written about the sport *to be obtained* in the Protectorate that it would be useless to repeat it here; it may not,

however, be out of place to add that any one contemplating a short shooting trip of three months or so, and prepared to "rough it" a little, could not do better than make a journey to this country, where for a small outlay he would get excellent sport and at the same time enjoy a delightful climate

PROPORTION OF STAFF TO REVENUE IN BURMA.

BY F. A. LEETE, F.C.H.

The figures given by F. A. L. in the August number are likely to be misleading as they stand, especially for Burma. To make the statement at all correct an extra column for "Unclassed Forests" is required.

The phrase, "there are no protected forests in Burma," is constantly cropping up in annual returns, but there is very little to choose between the status of "protected forests" in India and "unclassed forests" in Burma.

Unclassed forests in India do not come under the Indian Forest Act and the Forest Department has very little to do with them. The area of such forests is now relatively small and their value, direct or indirect, not worth much consideration. Here and there parts may be taken up, but the greater portion will eventually cease to exist as forests.

Protected forests come under the Indian Forest Act and the Forest Department does take part in their management. They include those forests which call for professional management, but to which it is not considered to be worth while to apply the elaborate procedure of reservation.

There are considerable differences in the recorded areas of such forests in the various provinces of India. In the Central Provinces there appear to be none, whilst the United Provinces have 9,393* square miles.

In Burma the term "Unclassed Forests," or "Public Forest Land" as it is called in the Forest Act of 1902, means "land at

* Not shown in F. A. L.'s statements. Managed by District Officers under the general control of the Conservator. Revenue practically *nil*.

the disposal of Government and not included in a reserved forest." There is no intermediate stage

2. F. A. L.'s figures apparently refer to 1902-03. For that year the recorded area of unclassed forests in Burma was 89,220 square miles.

Although it is very unlikely that anything like the whole of this large area will ever be reserved, yet there is very little that can be eliminated altogether, at present, as being of little or no value. A very large portion of the total forest revenue of the province is derived from these forests. Out of 60,475 teak trees girdled departmentally in 1902-03, no less than 25,179 were outside reserves.

As an example of the position with regard to the unclassed forests, the division of which I hold charge may be quoted. In Minbu out of a recorded area of 1,693 square miles of such forests, proposals were worked out in 1905 by Mr. J. Copeland for the reservation of 1,580 square miles, one-third as revenue yielding and two-thirds primarily for climatic reasons. About 300 square miles of forest still remains to be examined, showing that the original estimate was rather small.

In other divisions conditions are much the same. Progress with reservation is slow simply for want of officers. At the present rate it is quite possible that large areas may cease to be worth reservation before anyone has time to take them up.

To sum up, therefore, and to return to our starting point, even if we only take half the 89,220 square miles of unclassed forests as contributing anything appreciable to the forest revenue of 1902-03, instead of the receipts being Rs. 316 per square mile, they were not more than Rs. 107.

3. Coming, as I did early in 1904, direct from the Garhwal Division in the United Provinces to the Minbu Division in Upper Burma, the contrast between the two could not but make itself felt.

The following figures, taken from the returns for 1902-03, speak for themselves.

Particulars.		Garhwal.	[illegible]	Remarks
Area of division ..	sq. miles.	484×[1]	2,470×[2]	×[1] all reserved. ×[2] only 777 reserved
Average area of range ...	"	61	353	
" " beat ...	"	9	49	
Staff—				
Gazetted Officers ..	"	2	2	
Rangers	"	6	2	
Deputy Rangers .		5	8	
Foresters and Guards ...		56	54	Excluding peons.
Receipts	Rs.	2,23,748	70,124	
Expenditure—				
A. II For purchasers ..	Rs.	4,189	409	
III Drift	"	...	236	
VI Elephants and Stores	"	3,064	1,775	
VII Roads and Buildings	"	18,089	983	
VIII				
Demarcation and Settlements	"	26,890	95	
Surveys	"	22	11,483×[1]	×[1] 4 Forest Survey.
Fire-protection .	"	9,601	11,076	
Miscellaneous ...	"	2,134	1,096	
IX Miscellaneous .	"	618	226	
Total A	Rs.	65,507	27,380	
B. Establishments .	"	37,254	36,139	
Timber extracted by purchasers—				
(i) Round ..	c. ft.	111,143	247,790	
(ii) Converted .	"	356,207	1,625	
Receipts from above ...	Rs.	1,00,706	49,074	
Average per cubic foot ...	"	6 annas	3 annas	

4. The Garhwal Division consists of a continuous block of forest situated almost entirely in the hills. The forests must have been quite inaccessible, formerly, except on foot. From the very start of systematic management it was recognised that it was hopeless to expect any demand for the timber in the forests without liberal expenditure on roads. Road making was started some 30 years ago, and the division now possesses over 400 miles of cart-roads and 200 miles of bridle-paths all made and kept up departmentally. The result is that, for the last 10 years or more, the demand for timber has been fully equal to the supply. This applies not only to timber of good quality but also to refuse of all descriptions.

In the division there are 22 pucca forest rest houses costing on an average from Rs. 2,000 to Rs 2,500. In all the 8 ranges there are one or more two roomed houses for Range Officers and smaller houses in all beats for guards.

There is a daily post from outside, and a daily dâk inside. It rarely, if ever, takes more than a couple of days to communicate with any Range Officer or with the Divisional Office.

The forests are full of game. Perhaps the writer is the only Divisional Officer whose bag of tigers has been less than half-a-dozen a year. A fisherman could not wish for anything better than the Ramganga which flows for 30 miles through the middle of the forests.

5. The Minbu Forest Division comprises two districts, Minbu and Magwe. The forests extend up to the Arakan Yomas on the one side and to the Pegu Yomas on the other. These two ranges are about 100 miles apart. Half way between them is the Divisional Headquarters, Minbu, on the Irrawaddy.

The more valuable forests being inside the hills, a good deal of time is taken up with travelling from one side to the other. Six weeks, at least, of every camping season are spent outside the forests.

There are three posts a week from outside, but instead of taking one or two days to reach him, the Divisional Forest Officer's dâk may take anything up to a week.

The crop of forest offence is large, and unreported cases are probably far more numerous than those reported. The want of sufficient supervision over subordinates naturally results in plenty of malpractices on their part. The bigger the division in proportion to its staff, the longer the list of offences; police work takes up a far larger share of one's time than forest work.

Inside the hills there are no roads, only village tracks. Needless to say, it is rarely possible to go at more than a walk along these paths, and that a good part of the day is taken up with a 10 or 12 mile march.

There are three good forest houses in the jungles, and outside the hills there are good Public Works Department houses along the principal roads. In the cold weather a tent is constantly in use. From March to May one is glad to make use of any sort of temporary forest hut or of a road-side "Zayat," though it is hardly safe to dispense with a hat in the heat of the day in either of them.

6. Although the point of the foregoing remarks is to bring out the contrast between the two divisions, yet the differences in past conditions must not be lost sight of. In Garhwal we have the results of 50 years of work; in Minbu of only about 15. Only a few days ago I came across old papers in the Divisional Office showing that it was hardly safe to tour without an escort away from headquarters as late as 1891. Considerable progress has been made, but, to a new comer, it appears that a stage has been reached beyond which no appreciable progress is possible without such an increase of the forest staff as it is hopeless to wish for all at once.

With one forest guard in 49 square miles and one ranger in 350 square miles what can be done in the way of road-making with a view to the opening out of the forests, or in the way of fellings for their improvement? We are simply marking time, for as fast as we pick up threads in one direction we have to drop them in another, and this must go on until the staff is about quadrupled in all grades. Who can say how long this will take?

7. This line of thought naturally leads one to ask whether the existing staff is used as economically as it should be. More Forest Officers being so urgently needed, why take up so much of the time of those that are in the province with work that requires no special professional training? The measuring and passing of teak logs is quite mechanical, the looking after and disposal of drift, the inspection of saw pits, the checking of accounts at revenue stations, etc., could be done just as well by a man who was not a forester. For this sort of work a few week's training would be sufficient. Why not therefore have a separate branch of the Department recruited in the open market? In this way 20 or 30 men properly graded amongst themselves could be taken on, thus giving in a year or so a relief to the existing staff that would require at least 10 years at the present rate of recruitment of two or three juniors a year at the bottom of the professional list.

8. To any one who has spent all his service in Burma the above remarks may seem rather over drawn. It may perhaps, to some extent, be a matter of temperament and training but I find it hard to get up as much enthusiasm over work in Minbu as I did in Naini Tal, Bahraich, Kheri or Garhwal.

It will always be a pleasure to look back on the time spent in the latter Divisions. Every forest presents sylvicultural problems for solution, but simply to be able to theorise, in the intervals between prosecuting forest subordinates, as to what ought to be done, is quite a different matter from being able, not only to study the effect of actual cultural operations in the past, but also to carry them on a step oneself.

As far as climate goes Upper Burma at any rate compares more favourably with India than appears to be generally supposed outside Burma. I certainly had a very imperfect and distorted idea of the conditions prevailing in the province. Minbu appears to share with three or four other districts in the dry zone the unenviable reputation of being the hottest part of Burma. March, April and May are hot. The mid-day temperature indoors oscillates between 95° and 110°. Inside the jungles nearly every tree

is leafless, outside the jungles there is nothing to relieve the endless monotony of dust but occasional mango, pipal and tamarind trees.

During the other nine months of the year conditions are very different. From June to October, although the annual rainfall is under 30 inches, yet cloudy days are the rule rather than the exception. There is generally a good breeze blowing, and the punkah never need be kept going all day long. In December and January camp fires are a necessity. The night time is much preferable to Oudh even in the hottest months. I don't know what happens in wet places like Rangoon, but in Minbu a punkah is never required at night, and for the greater part of the year a blanket is not superfluous. Little as I at first wanted to come to Burma, yet I must admit the truth of what I was told before arrival by men who knew the province, that the country was the reverse of being as uncomfortable and unhealthy as it is painted in imagination by so many people in India.

THE DISTRIBUTION OF THE FOREST FLORA OF THE BOMBAY PRESIDENCY AND SIND

BY W. A. TALBOT, F.L.S., CONSERVATOR OF FORESTS, BOMBAY

III

Deciduous Forests.

The deciduous forests, spread as they are over more than three fourths of the total wooded area of the Bombay Presidency, possess a much less varied flora in which the African and Malayan elements are predominant, than the evergreens. The number of woody plants in all the deciduous classes does not much exceed three hundred species, about half the number crowded in the comparatively small region occupied by the heavier and denser evergreens. It is generally considered by botanists that materials do not exist for determining with accuracy the phytographical boundary line between the two great Deccan and Malabar botanical provinces, which include nearly the whole of the Bombay Presidency forest

region. This difficulty arises from the somewhat artificial and territorial nature of the boundaries of these provinces. South of Bombay the Palneys, Nilgiris and Bababuden hills extend across the Peninsula, and owing to the moist climate on the slopes of these mountains they carry with them far inland a number of Malabar species. For instance on the Bababuden hills in Mysore, the highest summits of which attain an altitude of over 6,000 feet, there are three distinct well marked altitudinal zones of vegetation. First comes the dry Deccan with its characteristic flora, from the plains up to 3,000 ft. Between 3,000 and 4,500 ft. there is a moist zone with a comparatively heavy rainfall, containing high mixed forests of intermediate type. This region is adapted for coffee growing and the forests have generally been removed or thinned to suit this cultivation. Coffee planting in Mysore is, however, excellent climatic forestry, as the rainfall is attracted and well distributed in the cultivated area. Above 4,500 ft. in the upper atmosphere with a very heavy rainfall and a low mean annual temperature, the character of the flora changes nearly abruptly. The rounded hills of this elevated region are open moorland covered with tall grasses, Strobilanthes sessilis, bracken and a varied flora of shrubby and herbaceous species, and in the ravines and sheltered situations is a dense forest growth of characteristic Nilgiri Shola plants. This, however, concerns the Malabar province outside the Bombay Presidency limits. From the Kanara district northwards, the boundary between the evergreen and deciduous floras is determined with comparative accuracy, and the dividing line between the tropical evergreens and intermediate deciduous forests is usually very distinct, particularly so on the Northern Kanara and Belgaum ghats, where isolated Kans are enclosed in deciduous forests. These Kans vary in extent from a few acres to several square miles and disappear entirely, when the annual rainfall is below 80 inches. Towards the east the separation between the deciduous forests of the intermediate and Deccan floras is not so apparent or well defined, As we go further in that direction the size of the trees diminishes, and whilst the elements of the dry Deccan flora become more and

more abundant a large number of intermediate species disappear altogether under the altered conditions of the climate. The forests of this dry region are more open and interspersed with cultivated lands, and it is usually only where the lands are barren and unfit for agricultural purposes that the jungles are allowed to exist. On the other hand the soil of the slopes and valleys of the ghat forest region is often deep and very fertile and the height of the trees and density of the growth are increased accordingly. The very unhealthy climate of this mountainous country accounts for the sparse population and the existence of the forests over such a large area.

In the Western Indian Peninsula the dry Deccan flora spreading from the north and east and the evergreen Malabar from the south and west have evolved an intermediate deciduous forest flora which in the humid climate of Mysore and North Kanara about the centre of the Malabar botanical province attains its greatest perfection. The evolution of the deciduous forests can in many places in North Kanara and Belgaum be traced to the degradation and destruction of the evergreens by human agency. There are, however, on the southern ghats large areas of mountainous country covered with mixed forests, some of which were probably never altered or affected by that means. The heavy rainfall and consequent humidity of the climate has eliminated a large proportion of the dry Deccan element. On the other hand, the species of Malayan origin Myristicas, Palms, Dipterocarps, Laurels, etc., are conspicuously absent. The origin of many of the well differentiated species peculiar to these intermediate forests is obscure and whether from Malabar, Deccan, or other sources it is difficult to determine. For example, Lagerstrœmia microcarpa, Bedd. is more nearly allied to L. parviflora the dry zone species than it is to its cogener L. Flos Reginæ, of distinctly Malayan origin. Oxytenanthera monostigma, the well known "choua" bamboo another species, is seldom found outside the deciduous moist intermediate forests. Its cogeners with the exception of O. Thwaitesii, from the Nilgiris and O. Stocksii, cultivated on the Kanara coast, all are found either in Burma or the Malay Peninsula.

Bauhinia foveolata, probably an endemic tree, is from its general appearance of Malayan origin. Pittosporum dasycaulon Thespesia Lampas, Kydia calycina, Hemigyrosa canescens, Eriolæna Candollei, Erinocarpus Nimmoanus, Melia dubia, Evodia Roxburghiana, Zanthoxylum Rhetsa, Stereospermum chelonoides, Zizyphus xylopyra, Leea macrophylla, Millettia racemosa, Desmodium gyrans, Indigofera pulchella, Mucuna monosperma, Flemengia strobilifera, F. congesta, F. involucrata, Pseudarthria viscida, Crotalaria dubia, C. Heyneana, C. leptostachya, C. fulva, Pterocarpus Marsupium, Grewia abutilifolia, G. tilæfolia, G. Microcos, Wagatea spicata Acacia concinna, A. Intsia, Albizzia odoratissima, A. Lebbek, A. procera, Pueraria tuberosa, Spatholobus Roxburghii, Bauhinia malabarica, Eugenia utilis, E. memecylifolia Casearia graveolens Hymenodictiyon obovatum, Embelia robusta *Bassia longifolia, Hoya retusa, H. Wightii, Strychnos Nuxvomica* Vangueria spinosa, Argyreia sericea, A. pilosa, Ipomœa campanulata Lettsomia elliptica, L. aggregata, Strobilanthes callosus, S. ixiocephalus, Calacanthus Dalzelliana, Nemacanthus sphærostachyus, N. trinervius, Barleria montana, B. Gibsoni; Dædalacanthus roseus, D. purpurascens, Clerodendron infortunatum, Symphorema involucratum, Solanum verbascifolium, Colebrookia oppositifolia, Loranthus gibbosus, L. lageniferus, L. obtusatus, L. Wallichianus, L. cuneatus, L. elasticus, L. trigonus, L. *Stocksii*, L. *capitellatus*, Phyllanthus indicus, Glochidion velutinum, Mallotus albus, Macaranga Roxburghii, Ficus asperrima, and Phœnix humilis are all found in the intermediate deciduous forests and are absent from the Deccan dry zone, and they may be either of Malayan or Deccan origin. Many of the trees widely spread throughout the Deccan have some of their specific characteristics modified and altered in the moist intermediate forests under the changed conditions of soil and climate which prevail there. There is no doubt that the long continued action of the human residents in these deciduous forests has profoundly influenced and affected their flora. The increasing population of one age extensively cleared large areas of forest clad land to be abandoned in the next and again slowly recovered with tree vegetation. The necessity of large open

spaces for cattle grazing, the burning of the jungles to improve the quality of the grasses, the constant lopping of species suitable for fodder or leaf manure, and the sylvicultural operations which have been in action from time immemorial with the object of supplying building timbers, firewood and secondary forest produce, all re-act on the climate by either diminishing the quantity of the annual rainfall in many places and adversely affecting its distribution everywhere. A close consideration of the variations of the great climatic factor, affecting the forest flora of the Indian Western Peninsula, the monsoon rainfall, opens up a series of botanical and economic problems of peculiar interest. Within a maximum rainfall of 350 inches on the highest ghats of Kanara and Satara and a minimum of a few inches in the Sind and Guzerat desert regions every grade of humidity of climate is found and the intensity of this humidity is re-acted on by the condition and density of the forest growth itself. The destruction of the forests in many regions is well known to be the cause of a diminished and insufficient rainfall. The dry and uncovered barren soil in these denuded countries possesses no longer sufficient power of condensing the moisture laden atmospheric currents In regions where the configuration of the land does not sensibly affect the direction of these currents or the amount of moisture, the absence of forests effectually prevents the storage and subsequent distribution of the condensed water The soil is washed away by sudden floods and fertile regions are transformed into tracts of mere desert. Uufortunately the ignorant and wasteful treatment of the Western Indian forests has resulted in the formation of large areas of barren unproductive soil The principal destructive agencies of the Bombay forests have been touched on in other parts of this article

A reference was made to the destruction of evergreen tropical forest in connection with the cultivation of the areca nut palm. In the deciduous Deccan forest area the annual recurring fires, the indiscriminate cutting and lopping and the browsing of goats have caused the disappearance of many species. The forests are open, often constituted of one or few kinds of gregarious fire resisting trees

which never attain large dimensions but generally remain small and stunted. Even in the intermediate deciduous forests which are well protected, some species approach extinction for example, Cordia Macleodii (Hadang), which yields a favourite timber for the construction of country carts has almost become extinct in the border forests of North Kanara on this account. The present treatment of the high timber intermediate forests of North Kanara and the consequent more or less successful attempts at keeping out fires have had some curious effects. In the fire protected area of the fine high timber forests of Gund and the Peshkardroog teak seedlings are very rare, and it is only on the broad burned fire paths that the seeds cracked by the heat have come up freely. Those which fall in the unburnt forest are destroyed by insects or rot and do not germinate. Attempts are made by planting to solve this sylvicultural problem and preserve this valuable species from diminishing from the growing stock in what is one of the most valuable teak areas in India.

MOIST DECIDUOUS FORESTS

These exist in the same area and under the same climatic conditions as the evergreens; they extend towards the west along the well-drained slopes of the ghats, down into the Konkan. The great humidity of the climate, equable high temperature and deep well drained soil from the denudation of the underlying metamorphic schists, are the favourable conditions under which these forests attain their greatest perfection. The usual period of active vegetation whilst not continuous throughout the year is much longer than in the dry Deccan forests The short time the trees are bare of foliage and the green herbaceous undergrowth often considerably lessen the danger of forest fires occurring. In the Peshkardroog and other great teak and mixed forests of the Supa division of North Kanara, fire tracing can scarcely be undertaken before the 15th March as the jungle refuse will not burn, and as heavy rains often fall in May and sometimes earlier the annual fire danger period is reduced to less than two months. The fires, however, cause infinitely more damage in these forests when they do occur, owing to the accumulated dry material, than in the small open

jungles of the Deccan regio, with its scanty undergrowth The chief differences which distinguish the moist deciduous from the dry deciduous class are in the former the larger size of the trees mostly from seedling origin, the much greater density of the forest and the existence in either class of a large number of different characteristic species. A number of trees are common to both classes which yield valuable timbers and are consequently prominently brought to the observer's notice. The principal of these is the teak (Tectona grandis), and in the North Kanara ghat forests this species locally abundant attains to large dimensions and yields timber of excellent quality. In the dry Deccan and lighter rainfall zone forests the size of the teak is greatly diminished, and the numerous stems originally from shoots only yield poles containing a large proportion of sap wood and not convertible into logs. In the Surat Dangs and the Akrani forests of the Khandesh district teak of somewhat large dimension and convertible into squared logs is still to be had but rare. Sir D. Brandis mentions on p. 359 of his "Forest Flora of N.-W. and C. India" having measured in the Khandesh Dangs teak trees 60—70 feet long to the first branch. The principal other species common to the intermediate deciduous and Deccan deciduous jungles are Blackwood (Dalbergia latifolia), Jamba (Xylia dolabriformis), Ain (Terminalia tomentosa), Harda (Terminalia Chebula), Hela (T. belerica), Kindal (T paniculata), Temru (Diospyros melanoxylon), Awla (Phyllanthus emblica), Ghela (Randia dumentorum), Parati (Pavetta indica), Mohwa (Bassia latifolia), Jambul (Eugenia Jambolana), Kumba (Careya arborea), Apta (Bauhinia racemosa), Phulas (Butea frondosa), Karmal (Dillenia pentagyna), Hedu (Adina cordifolia), Kalamb (Stephegyne parvifolia), Kura (Ixora parviflora—an evergreen), Tewas (Ougeinia dalbergioides), Kupila (Mallotus philippinensis). There are few natural orders and genera peculiar to the deciduous forests, nothing similar to the characteristic Myristicas, Dipterocarps and Palms of the evergreens. A list of the principal species indigenous in these moist intermediate deciduous forests is given in a former paragraph

DRY DECCAN DECIDUOUS FORESTS.

These small forests which cover large areas both in the eastern parts of the Konkan and Deccan districts are confined to the zone with an annual rainfall below 50 inches. They degenerate into mere scrub jungles further towards the east and are easily distinguished from the moist deciduous class by the smaller size of the few, mostly gregarious constituent trees and their more open distribution. The struggle for existence is not between the constituents of the flora but against the inhospitable physical surroundings, and owing to the dry climatic conditions, on a soil exposed for most part of the year to a hot sun, the trees common to both classes are stunted and seldom attain large dimensions. A number of distinct drought resisting resinous Burseraceæ, thorny and prickly species (Euphorbias, Mimosas, Acacias and spinous Rubiaceæ) are also characteristic of these forests. The influence of the annual forest fires is very great and effectually prevents the stems from attaining large dimensions. The principal trees and shrubs indigenous in these forests and not found in the other classes are Mimusops hexandra (probably not found south of Thana), Prosopis spicigera, Hardwickia binata, Cæsalpinia sepiaria, Mundulea suberosa, Rhus mysorensis, Dodonæa viscosa, Vitis auriculata, V. quadrangularis, Ximenia americana, Chloroxylon Swietenia, Azima tetracantha, Jasminum auriculatum, Acacia arabica, A. eburnea, A. tomentosa, A leucophlœa, A. suma, A. Catechu, var. sundra, A. ferruginea, A. latronum, Carissa spinarum, Mimosa rubicaulis, M. hamata, Cordia, all five species, except C. myxa, which is also found in the moist deciduous, Salvadora persica often on saline soil, also found near the sea coast in North Kanara, Soymida febrifuga, Boswellia serrata, Balanites Roxburghii, Ailantus excelsa, Anogeissus latifolia, Argyreia cuneata, Gardenia turgida, Feronia Elephantum, and Aegle Marmelos, Grewia salvifolia, G. populifolia, G. hirsuta, Cochlospermum gossypium, Capparis grandis, C. sepiaria, C. aphylla, C. zeylanica, Cadaba indica, Mærua arenaria, Lantana indica, large Euphorbias (E. Tirucalli, E. tortilis, E. neriifolia, E antiquorum) and others. Along the North Kanara border and extending some way into the

Dharwar district the principal trees of economic value are (Tectona grandis) teak, (Terminalia tomentosa) ain, (Anogeissus latifolia) dindal, (Schleichera trijuga) kusumba, (Dalbergia latifolia) blackwood, (Terminalia chebula) harda, (Pterocarpus Marsupium) honne, (Santalum album) sandalwood, and (Adina cordifolia) heddi Cassia auriculata, C. glauca and Carissa Carandas prevail in the undergrowth. Dendrocalamus strictus is the only bamboo, and Phœnix sylvestris, the only palm indigenous in these dry forests. In May, before the monsoon commences, the vegetation becomes active and the jungle is quite green before the regular rain falls. Cassia auriculata, is one of the most widely spread and abundant shrubby species of the Deccan area and is found in open situations and as undergrowth in many of the forests from the Mysore frontier in the south to the Panch Mahals in the north. In the Sholapur district one of the principal sources of forest revenue is obtained from the sale of the bark of this shrub. Dense impenetrable thickets of Lantana aculeata, cover large areas of waste land in the S. M. country and North Kanara. This bush (not to be confounded with L. indica, an indigenous species), was introduced as an ornamental shrub some forty years ago, and has now invaded even the moist region of Belgaum and North Kanara, where its eradication has become a forest problem of some importance. On the deep "Regur" black soil of the plains, considerable areas are covered with open forests of the valuable Babul (Acacia arabica) mixed with A. eburnea and A. leucophlœa. The small trees and undergrowth of these grassy woodlands consist of Cassia auriculata, Calatropis gigantea and C. procera, closely allied species, distinguished principally by the different forms of their coronal appendages. Capparis divaricata, Balanites Roxburghii, Prosopis spicigera, Dichrostachys cinerea, Ziziphus nummularia, Hibiscus trionum, Mormodica cymbalaria and Anisomeles malabarica. A reference was made to the Dharwar series of transition rocks in the opening chapter. The downs and low hills surrounding the town of Dharwar constitute part of this formation and the soil is mostly red, ferruginous, hard and barren on the higher levels. The annual rainfall which is somewhat uncertain

and variable seldom exceeds 25 inches. The ligneus vegetation of this region has been reduced by constant cattle grazing and cutting of the trees and shrubs for firewood and field fencings. There is only a scanty scrub left consisting principally of clumps of thorny stunted trees, shrubs and climbers.

The principal are: Gymnosporia montana, Acacia Catechu, A. eburnea, A. leucophlœa Flacourtia Ramontchi, Carissa Carandas, Streblus asper, Capparis divaricata, Flueggia microcarpa, Dodonæa viscosa (often gregarious), Grewia pilosa, Ixora parviflora, Canthium parviflorum, Ehretia buxifolia and Bridelia stipularis. During the rainy season the showy purple bell-shaped flowers of Argyreia cuneata are conspicuous. Sopubia delphinifolia, Biophytum Reinwardtii, Ocimum canum, Blepharispermum subsessile, and Ionidiun suffruticosum are common herbs.

A few of the principal climbing species are:—Celastrus paniculata, Cæsalpinia sepiaria, Cylista scariosa, Zizyphus Œnoplia, Asparagus racemosus, Capparis sepiaria, Cocculus villosus, Cadaba indica, and Grewia hirsuta.

Five or six miles to the north of Dharwar are small protected jungles, not altogether destroyed by collectors of firewood. In addition to the above mentioned species, they contain small stunted trees of Anogeissus latifolia, Balanites Roxburghii, Bauhinia racemosa, Tectona grandis, Santalum album, Cassia fistula, Butea frondosa, Diospyros montana and Alangium Lamarkii. The leafless Sarcostemma brevistigma, Jasminum auriculatum and J. arborescens are to be added to the list of climbing shrubs.

On the dry stony Kuput hills in the Dharwar district the forest vegetation is very scanty, and the principal trees are usually of very small size and sparsely distributed. In the more favourable situations Acacia arabica, a variety of Morinda tinctoria, Stereospermum suaveolens, Carissa spinarum (an evergreen prostrate or erect shrub with small sweet berries) Pongamia glabra, Canthium parviflorum and Cassia auriculata are the principal species in these almost barren hills, 30,000 acres in extent, and over a large proportion of which even Opuntia and the columnar Euphorbias do not grow. Only spear grass, affording scanty grazing early in the

season for herds of sheep and antelope, appears to thrive. At the base of the hills "babul" mixed with Acacia latronum, Mimosa rubicaulis, M. hamata, Capparis divaricata, and the red berried C. aphylla constitute the scrub. Near Badami in the Bijapur district, on the Kudapah sandstone formation, the flora is peculiar and varied. Owing to the xerophitic conditions in a dry almost desert climate and a rocky or sandy soil, the trees are small and stunted, but in favourable seasons when rain falls abundantly the vegetation contains quite a number of distinct species, probably evidence of the remains of an ancient flora. The following is a list of some of the more remarkable plants found in this locality.

TREES AND SHRUBS.

Melia Azadirachta Linn, Gyrocarpus Jacquini, Roxb., Ailantus excelsa, Roxb., Mundulea sub rosa, Bth., Chloroxylon Swietenia, DC., Wrightia tinctoria, Br. var. Rothii, Vitis vitigenia, Roxb. (a small thick stemmed tree), Mimosa rubicaulis, Lamk., Grewia salvifolia, Heyne., Cordia fulvosa, Wight., C. monoica, Roxb. and Ficus tomentosa, Roxb.

UNDER SHRUBS AND HERBACEOUS SPECIES.

Sida cordifolia, Linn., Crotalaria bifaria, Linn., C. ramosissima, Roxb., C. hirsuta, Willd., Indigofera tenuifolia, Rottbl., I. argentea, L. var. coerulea., Alysicarpus monilifer, DC., Rothia trifoliata, Pers., Desmodium Rottleri, Baker., D. rotundifolium, Baker, Eleiotis sororia, DC., Tephrosia Hookeriana, W. and A., T. purpurea, Pers., Cleome tenella, Linn., Mollugo Cerviana, Seringe., Aerua monsonia, Mast., Allmania albida, Br. var., Convolvulus Rottlerianus, Chois., Justicia glauca, Rottl., Sesamum laciniatum, Klein., Mollugo nudicaulis, Lamk., Andrographis echiodes, Nees., Lepidagathis cristata, Willd., Kalanchoe spathulata, Nees, Ipomœa pestigridis, L., Pouzolzia Bennettiana, Wgt., Barleria tomentosa, Roth., and Actinopteris dichotoma, Forsk., (a remarkable fern).

In the eastern parts of the Belgaum district on similar quartzite sandstones the small deciduous forests contain amongst other species the showy flowered Sophora Wightii, Chloroxylon Swietenia, Ximenia americana Cochlospermum gossypium, Colum-

nar Euphorbias and Opuntia, Strychnos potatorum (Nermali), Mundulea suberosa, Ficus tomentosa, also found near the sea coast, Wrightia tinctoria, Vitex Linnaei, Cordia Macleodii, C. fulvosa Dalbergia paniculata, Clerodendron phlomoides, Grewia pilosa, G. villosa, G. populifolia, Limonia acidissima, Dolichandrone falcata, Givotia rottleriformis (*Palki*), Gyrocarpus Jacquini (Zaitan), and Hardwickia binata (Anjan), this latter tree is sparsely distributed in these dry forests. A small forest of Anjan is found near Renebennur in the Dharwar district, and only in Khandesh does it become fairly common on the basaltic trap of the Satpuras, where it is met with sometimes of fair size, large enough to yield railway sleepers, mixed with Bombax, Teak, Ougeinia dalbergioides Terminalia Arjuna, Sterculia urens Bassia latifolia etc. Some of the hills near Dhulia are covered with an open growth of "Anjan" which is only preserved from extinction by the continual lopping of young branches and leaves for fodder, by its strong capacity for shoot reproduction. Another remarkable species constituting almost pure open forests, extending from the Khandesh Satpuras on to the Central Provinces, is Boswellia serrata (salai). This white barked tree which belongs to the same order as Balsamodendron and Garuga (Burseraceæ) is of African (Arabian) origin and yields a kind of balsam or frankincense (kundar or labana). The forests of salai with the associated *karai (Sterculia urens, situated on the trap of* the Satpuras present during the dry season a weird and desolate appearance.

There are traditions of the Deccan being well wooded in former (prehistoric) times. If this was so the conditions of climate and soil must have since radically changed over vast areas. Human agency and the indiscriminate browsing of sheep and goats have assisted in the denudation of this region, but it is also open to doubt whether real forests ever did exist in many of these semi-desert tracts of country. For more than 30 years futile attempts at reboising these barren regions have been made, and much money has been spent on broadcast sowing and other practically useless operations. Nurseries for the distribution of seedlings, proved to be failures, have had to be abandoned.

Where water is not available it is beyond the wit of man to transform stony wastes into leafy forests.

S. Kurz in his introduction to the "Forest Flora of British Burma" refers in an appendix, to the jungles where bamboos are predominant. In the Bombay Presidency the distribution of the various kinds of bamboos is intimately connected with the different evergreen and deciduous floras, and the jungles in which bamboos are the prevailing element can scarcely be considered as forming either a sufficiently extensive area or a separate distinct class of forest. The indigenous six species belonging to four genera are distributed as follows: -

BAMBUSA ARUNDINACEA, RETZ.

The hollow glabrous bamboo, the Dougi or "Spiny bamboo" of Western India and the largest of our indigenous species, is generally spread throughout the Presidency both in deciduous forests and along moist river and nallah banks. The bamboo clumps are associated with the members of the local floras, more or less choked by the dense shade and usually sparingly represented. Bamboos are light loving species and do not thrive in the undergrowth of the tropical evergreens from which forests they are conspicuously absent. The Dougi attains great perfection in the intermediate deciduous ghat forests of North Kanara. In favourable localities clumps of 80—100 culms, 100 ft. long by 5 ft. with 8 in. as the diameter of the thickest internodes. This species flowers generally and dies down after long and irregular periods of more than 30 years. In the forests of North Kanara, from Arbail inland, there was a general flowering of the large bamboo from 1864 till 1866. This fact is well authenticated as there was a scarcity or partial famine in those years when the natives of the ghat and coast districts collected the seed which served them in lieu of cultivated grain. The writer remembers seeing in these forests in 1878, eleven years after the general flowering took place, the large fallen and partially decayed clumps. These dead and dry masses of highly inflammable material were surrounded by the continuous and dense undergrowth of young seedling bamboo two to five feet high, in many localities quite impenetrable.

The clumps did not differentiate until several years afterwards. No general flowering of Bambusa arundinacea has taken place in North Kanara or Belgaum since 1864—66. The conditions which favour a general flowering of the different kinds of bamboo, arrived at maturity, are very obscure and only vague conjectures on this subject have hitherto been hazarded. It has been stated that isolated clumps of Bambusa arundinacea in flower are met with in various localities. The writer has never seen during a residence in India of over 28 years either a general or partial flowering of this important species although living in the region where this bamboo is found in abundance and anxious to observe and record the fact. During the season of 1905, whilst travelling through the North Kanara thorny bamboo area, it was observed that a number of the culms in each clump were dead. It will be interesting to note whether this is an indication of a fresh flowering being imminent, or whether if the favourable conditions necessary do not occur the clumps now 40 years old will die without flowering at all. Owing to the prevalence of the large curved spinous branches at the bases and some way up the culms the natives usually cut off and content themselves with 40 or 50 feet of the culm tops, many bamboo clumps of this species therefore present a mutilated appearance. The new yearly culms appear during the rainy season and grow with very great rapidity. Bison and sambhar are very fond of these young shoots.

BAMBUSA VULGARIS, WENDL.

The yellow and green striped bamboo, a native of Ceylon, is only found as a cultivated usually ornamental species in the Bombay Presidency.

DENDROCALAMUS STRICTUS, NEES.

The medium sized, deciduous, unarmed glabrous "Male bamboo" or Shib, sometimes found with solid culms ("Mace") is very widely spread and abundant in most of the Bombay forests, except of course the tropical evergreens. It is often associated in the intermediate deciduous or mixed hill forests with the thorny bamboo, and like that species it flowers after considerable intervals. These intervals are however of shorter

duration and the flowering does not take place simultaneously over such large and extensive areas. Isolated clumps and for that matter large patches of forest of Dendrocalamus in flower are comparatively frequently met with. The record of these general flowerings is now more carefully kept and an accumulation of the relative observations will help to clear up some of the present obscurity in our knowledge of this subject. There is only one species of Dendrocalamus generally distributed throughout India. The annual culm shoots appear in September or October, and growing with the greatest rapidity soon elongate sufficiently to escape the attacks of bison, deer and other animals.

OXYTENANTHERA MONOSTIGMA, BEDD.

The culms of this small bamboo are covered when young with brown tomentum. They are much softer in texture and are generally more solid, that is, with a smaller stem cavity, than either of the foregoing common glabrous species. Owing to the abundance of these O. monostigma ("Chowa") has small commercial value. The presence of this bamboo in the deciduous intermediate forests of the ghats and Konkan is of considerable botanical interest as it is confined to these and does not extend either into the evergreen or dry Deccan regions. The chowa is usually found with the culms separated and does not affect growing in clumps nearly to the same extent as either Bambusa or Dendrocalamus, and it does not in consequence exercise the same strangling influence on the general vegetation within the radius of its distribution. Flowering clumps are frequently met with in North Kanara and there was a general flowering of this bamboo in the hill forests of the higher Satara ghats during 1904.

OXYTENANTHERA STOCKSII, MUNRO, *konda, k.*

A strong almost solid bamboo, used for punting, poles, etc., in North Kanara is generally cultivated near the villages along the Kanara and Konkan coasts. It is very rare in the ghat forests.

OCHLANDRA RHEEDII

VAR. *sivagiriana*, GAMBLE, *Hooda, k.*

This slender, unarmed, rough stemmed and hollow bamboo, often scarcely more than a very large reed growing in dense clumps

of many (several hundred) culms, is found in the moist and heavy rainfall zone along the ghats where it is very common and it also extends down into the Konkan on the west. The Hooda is abundant in North Kanara along the banks of streams and nallahs and is sometimes found along the borders of the tropical evergreens. The slender whip-like culm tips bend and where they meet with support become scandent and grow to considerable lengths. This species flowered generally over large areas in 1896 in North Kanara, where it had, as far as I can ascertain, never before been seen to flower. It is of small economic value but is sometimes used in the construction of the temporary bridges on the Kanara ghats during the south-west monsoon.

The principal gregarious trees in the deciduous forests are Teak (Tectona grandis), Jamba (Xylia dolabriformis), Babul (Acacia arabica), Catechu (Acacia Catechu), Salai (Boswellia serrata) and the Ichil (Phœnix sylvestris). In the humid laterite ghat region various Strobilanthes, Sun ichil (Phœnix humilis), and Tale (Corypha umbraculifera) cover considerable areas often to the exclusion of other species.

REVIEWS AND TRANSLATIONS.

THE FORESTER.

"The Forester"—by John Nisbet, D. OEc.—Blackwood, London.

Dr. Nisbet has brought out a new book on Forestry entitled "The Forester," in two handsome volumes, the first dealing, after a lengthy "Introduction," with Sylviculture and what he terms "the British Sylva"—an account of each tree by itself—and the second with the rest of the subject. We may here consider Vol. I.

The preface shows that "The Forester" is yet another amplification of Brown's book of that name, but is in reality quite a different book. This is clear enough from the contents, a great deal of which could never have appeared in the original book. Dr. Nisbet states that "The Forester" incorporates the essence of all the books he has written on the subject during the last thirteen years, besides new material. In these days scientific books cannot contain a great deal of original material, but must for the most part, if they are to be complete and useful, be a compilation of the best that has been thought and written to date upon the subject, and such "The Forester" appears pretty well to be but with many shrewd deductions and observations of Dr. Nisbet's own.

"The Forester" seems to be the nearest approach to Dr. Schlich's classic Manual that we have yet had in English, in so far as usefulness is concerned, and although one might at first be inclined to doubt the need for a second Manual on these lines, still the new book is more directly addressed to owners of British woodlands than is Dr. Schlich's Manual, which was of course drawn up with a different essential object.

"The Forester" is to be welcomed as a weighty addition to progress in true forestry in Great Britain. Dr. Schlich is, we think, the first and the chief exponent at home of what has naively been called "The New Forestry," and Dr. Nisbet is, these days, ably seconding him. Indeed the very book with the above naive

name to which we allude is itself a most gratifying sign of a rational and progressive movement among Foresters in England, and incidentally we commend it to our readers.*

"The Forester" should be a real help to English Forestry, nor need any susceptibilities, tender though they are, be hurt, for although Dr. Nisbet states, directly enough, that there is much to be desired in British Forestry, and indicates the weak spots; he yet writes, we think, sympathetically and, in some directions, hopefully, and he indicates—what has probably not been sufficiently done in the past that the conditions governing forest work in England are not in every respect similar to those of the Continent not merely economically, but also sylviculturally speaking.

We gather from this book that Dr. Nisbet is inclined to think that there is not, after all, such a very open field for Forestry in the British Isles as has been stated. He no doubt thinks there is a fair field, but he appears to consider it to be more restricted than is generally supposed He estimates that of the 16¾ million acres of waste only some three and a half *millions would probably be plantable with a fair chance of profit,* and he points out that to be really profitable forests must be formed in large blocks, which could only be done by the State and some few large land owners.

The estimates as to profits have, he considers, been based on two problematical data. On "National Economic" grounds, however, Dr. Nisbet is more thoroughly in favour of the formation of British forests than on the ground of a profitable speculation. The difficulty is said to be that forest industries are not, as on the Continent, in existence. Yet that there are centres absorbing great quantities of forest produce is clear enough from the fact that Great Britain's imports of wood, or wood materials, are some £30,000,000 annually, and are rising Forest industries surely would gradually develop as the forests developed, and this might be taken as a certainty. It is the fuel and the produce of *intermediate thinnings* that sometimes fail to find a market, for material of this class cannot bear a great deal of carriage, but

* "The New Forestry"—Simpson (Dawson and Brailsford Sheffield, 1900).

when timber has grown large it, at least, would bear carriage. It is admitted that the British Isles could grow as good timber as the Continent. Surely, then, forests grown on correct principles of Forestry could not fail in the long run to take up as great a part of the vast, and ever-growing, market as they had produce to supply. As the State forests grew, and with them forest industries developed, private land-owners too would, we think, also find the planting of woodlands profitable. And even in the matter of expense there is not such a great deal to be reckoned with; the usual fault is that too much, rather than too little, is done in woodlands. We must say we remain optimistic on the subject of British Forestry, but nothing can be done without perseverance, and in forestry more than in anything else—a fact we ourselves in India, professional foresters, constantly forget. What numberless experiments are dropped as failures because they are not immediately successful. Of course they are not, and if we would only stop to think we would realise it. It is, we think, one of the weakest spots in our administration, how entirely insufficiently we work out our experiments. Nor is it merely haste, we fear, and a desire to get forward; if we were quite honest we should admit that often our predecessor's experiments did not interest us and that we wanted to get on to one of our own. But nature will not be hurried, and if we will not be patient, we shall not know her secrets. The difficulty of course with us in India is the constant transfer of officers, but we hope the time is coming, not indeed when transfers shall cease—for they have some points of advantage—but when we shall have a central body charged with the collection and classification of data, and with the *continuous* carrying out of experiments, working these really to a finish.

The "Introduction" must have required much care and research. It gives a history of forestry in England from the earliest times, and we do not know that this is anywhere else to be found in such a complete and compact form. *Shikar* was of course the beginning of things. Saxon kings assumed the over lordship for this purpose, and royal woods arose, of which the first mention is in 827 under Egbert, but the value of woods for

pannage of swine was recognised as early as 690. The forests were probaby composed of oak, beech, birch, pine and hazel, but the pine disappeared for a season, to be reintroduced in 1776. *It was under the Norman kings, who were very keen sportsmen,* that forest laws first crystallised into definite shape or at least were strongly insisted on, and most severe they were. Shikar has ever been the cause of much feeling and jealousy, no doubt as being a primitive instinct. The forest enclosures were sometimes most cruelly made, and for centuries there was a constant conflict between the kings and the barons about forest matters. Doomsday Book (1016–1086) mentions the following forests: New Dean, Windsor, Whichwood (Oxfordshire), Wimborne and Gravelinges (Wilts)—but these were by no means the only forests. In Essex, for example, was one, and the way in which the king would extend this forest (on one occasion even to the whole country) and the barons then make a "perambulation of the bounds," and cut away vast areas, was extraordinary. In 1184 the Assize of Woodstock was the first genuine code of forest laws having general application throughout the realm, which was then put upon a definite footing and made independent of the common law, as it long remained. To show how much stress was laid on the forest law it may be mentioned that even the very powerful clergy, who were at one time exempt from the common law, were not exempt from the forest law. This was an arbitrary code, but at least it abolished death penalties and mutilation. Magna Charta itself was concerned with the forest law, for King John had enclosed large areas as forest. The tyranny of the forest laws gradually became less and less, and departed with the Commonwealth. There were special forest Courts, held at the "Justice Seat," at intervals, under very exalted judges indeed, termed "Justices in Eyre." Besides the Justices in Eyre the forest administration consisted of rangers, verderers, regarders, foresters, agistors, and woodwards. These were practically only concerned with the game and the forest laws concerning game, except the woodwards, who were the only real forest officers as against game keepers. From among all these old forest terms (and there were many others) the English have

always a large body of tradition upon which to draw when a forest nomenclature is required, so why the Americans should use such a term as "field assistant" is not apparent. "Forest guard," one is always inclined to think of as a foreign term, yet it is a direct translation of "woodward" and thus more English than many of our other terms. In point of fact the use of woodwards only gradually dawned on people, as was natural when there was an excess of forest, and although they existed from early times the value of the trees of the forest does not appear to have been much appreciated till after the Wars of the Roses. Thereafter, as the centuries went by, more and more anxiety as to the national outlook from a forest point of view was shown, and a continuous string of Acts of Parliament, apparently barren of result, is to be found on the Statute Book down to our own times. The last important step of the Legislature was the appointment of Mr. Hanbury's Commission in 1902, from which some minute benefit appears to have resulted.

Chapter II of Part I is very important from the point of view of foresters at home, but we have already touched on it above. It concerns forestry prospects generally in Great Britain and the subject of forest education.

Part II is the "British Sylva," and takes each tree individually. A very large number of the trees mentioned will interest the arboriculturist rather than the sylviculturist. The method adopted for the forest trees is a useful one, namely to take each tree under separate heads, generally distribution, description, economic value, soil and situation, cultivation, sylvicultural characteristics, and sometimes continental notes. This last is a particularly happy idea. Dr. Nisbet is an advocate of conifers in Great Britain, that is, he believes that conifers as a general rule may preferably be planted, notably the larch, Douglas fir and Scots pine. The larch is, as we know, improperly grown in pure woods in Britain, and the error is being bitterly punished by the *Peziza willkommii*. Nevertheless in mixed woods there is a great place for the larch. The Douglas fir is an exotic species which shows signs of being very usefully introduced, but it has,

like larch, its own special enemies and these must be carefully watched. It is not only a very good timber but fast growing. This part of the book will be useful for reference. We think the heads under which each tree is treated might be further subdivided with advantage, for if, for example, the student desired to find, for any species, the aspect principally affected, or the altitude, or the extent to which it demanded light, or whether it grew normally as pure forest or in mixed forest, and so on, he would require to hunt a little, and as it is precisely isolated points like these that have generally to be looked up, it would have been a gain had they been given as definite heads in the description.

Part III, some 176 pages, is *Sylviculture* proper, and this part will really interest the forester most in a book of this kind. In the first place we do not like the plan adopted of splitting up the great Methods of Treatment into parts which are to be found in places separated by many pages. From page 359 there are some eight pages concerning coppice and high forest. Thence we go on to page 434, where cleaning and thinning are dealt with in eleven pages, and this is followed by regeneration, up to page 474. In the opinion of the writer of this review (with which no doubt many people may differ) the methods of treatment are preferably given the principal place in a book on sylviculture, and dealt with at length, each method being considered by itself, save where comparisons are necessary, and thrown up into high relief. Then the suitability of the principal species for the various methods of treatment might be considered, and the special ways of dealing with these principal trees in any given method (*e.g.*, how differently to deal with oak, or with beech, in a given high forest system) might follow. The other sylvicultural facts should, we think, be given a subsidiary place; the general physiological facts, classification of soils, and so on, coming first. Thus we would not treat of thinning as a separate matter, but would deal with it when describing the method called by Dr Schlich "shelter wood compartment," and other names by other persons. When thinning came in again under "selection" (another imperfect term, as our author truly remarks), or other method, less would need to be said on the point.

We would treat regeneration in its own place under each method of treatment, rather than take it separately with a consideration of its relation to each method of treatment in turn. Our reason for thinking this is that we believe less confusion results in the student's mind when the method is the skeleton to which the various facts of sylviculture are attached, rather than the other way about. It is important to have your method of treatment very clearly defined in your head when you set out to make a forest operation.

We have seen considerable confusion result when the operator set out to mark trees and was rather vague as to the system on which he was marking. Incidentally it may be remarked (though this is not exactly *a propos* of the present question) that in India the various methods of treatment are not as clearly defined as they should be, and are variously interpreted by different people. Undoubtedly we want here an authoritative arrangement of systems, with different names authoritatively laid down, not only for the well-known systems or methods, but also for the several varieties in systems which at present are included under one name. Confusion results otherwise. That by the way ; in the present case we are merely saying that we think the great European methods of treatment should be brought out into high relief, for although trained foresters know all about them manuals of sylviculture are for students also, and in the present case for persons not fully acquainted with continental forestry. We are not impugning the correctness of the description of the various methods of treatment—we would only arrange them differently. We, however, think that much more could have been added with advantage.

To revert for a moment to the question of nomenclature above mentioned, we think that besides the need for an authoritative definition of the different Indian methods of treatment there is a great need also for an authoritative set of general technical terms—a technology which both the Instructors of future Indian foresters at home and Indian foresters out here accepted and held to. This at least we think all will agree to. Thus Dr. Nisbet objects, correctly as we think, to the term "selection," as being misleading, but then still less do we like his term "sporadic, or casual fellings." Still we

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are not prepared off-hand to find a substitute. For such a purpose nothing short of a committee, with much discussion, is requisite. Dr. Nisbet calls the "shelter wood compartment system," or "mode des éclaircies et de la régénération naturelle" (quoted by him as "futaie regulière procédé par coupe successives")—"regular partial clearances," or "uniform natural regeneration." Surely D'Arcy's term "successive regeneration fellings" would be preferable. But who is to settle all this? Authority, we think, should take the thing up.

To take Part III more in detail, Chapter I gives the scientific foundations of sylviculture the physiology of forest trees, agricultural chemistry and soils, both chemically and physically dealt with. These things are dealt with in twenty very interesting pages. We then pass, in Chapter II, easily and naturally to the sylvicultural characteristics of forest trees—climate, soil and situation, relative demand for light, shape of root, stem and crown, rate of growth, reproductive power, maturity and longevity—in easy sequence. Then come general characteristics—gregarious or other tendencies of species, density and canopy, and then we come, rather suddenly, upon notes concerning coppice and high forest.

Chapters III and IV are about artificial restocking and give much useful information. There is also much interesting matter concerning the planting up of sand dunes and other waste. If ever artificial afforestation is taken up at home it is satisfactory to feel that this part of forestry is thoroughly understood there. There is this to be said about artificial regeneration, as opposed to natural, that nature's way appears to be to alternate the species. A M. Gerdil in France has lately drawn attention to the curious fact that if in a mixed forest of, say, silver fir and spruce the former is in the minority its natural regeneration will be the more successful, and *vice versâ*. Whether it be wise or not to go against this law it can apparently be overcome only by artificial restocking. Votaries of the French school, which lays so much stress on natural regeneration, are perhaps inclined to take only a limited interest in artificial restocking, yet they will admit that under certain circumstances reliance on artificial work may actually be wiser than reliance on natural regeneration, not merely in large blanks but in forest of a normal type also. We

fear it is the fact that the modern trend of things in Europe is rather to discard natural regeneration, for somehow it seems regrettable. The writer of this review has seen a spruce forest in Austria where the coupes were clear felled and restocked artificially with only five per cent of failures. And there are cases even in India where artificial regeneration is necessary—babul forest, for instance, is simplest regenerated, we think, by artificial sowing, and in some deodar forests the opening of the canopy by felling or girdling to induce a natural growth of young deodar often results merely in an impenetrable growth of weeds (Indigofera, Desmodium, etc., etc.). Fortunately the way to artificially restock deodar forests has been fairly well learned and the work can be done successfully and cheaply, while as regards babul artificial sowing, in years of normal rainfall, is perfectly easy and extremely cheap. Still we in India must in the main of course trust to natural regeneration with our vast areas. Although we so often find a wonderful advance growth in our fire-protected forests we must not be misled into thinking natural regeneration easy. The sad fact that several of our principal species have a tendency to spring up and then die back for a series, some times a long series, of years must be reckoned with. Were we to take, say, mature sal forests, with a complete canopy, and attempt a natural restocking according to the method of successive regeneration fellings as carried out in Europe, it would probably take us a great number of years, because of this unfortunate tendency in sal. Artificial regeneration being out of the question our proper way would probably be to open out the leaf canopy of the old forests a number of years in advance gradually, but eventually more freely than is usual in this method of treatment, and so avoid a long period of waiting till the young plants had become strong enough to go ahead, and even then we might not be successful. Probably the Group method is really preferable, for in that way we should be able to pick and choose our spots for felling throughout a whole periodic block, and not be tied down to the restricted area of a coupe. And it is important to reflect that, owing to the above-mentioned tendency of dying back and also to the rapid growth of grass and weeds in an Indian forest when much opened out, we shall be forced, at the

time of our regeneration felling, to *first find* our advance growth on the ground before removing the overhead or neighbouring cover, and shall not be able to act as in the Group method in Europe when, at the period of the regeneration felling, they fell groups of trees in order to allow space for seeding in groups. Of course the "preparatory thinnings" of the previous rotation will remain necessary, but when the actual moment for what would otherwise be the seed-felling arrives we must, we think, in India have our young growth already there, we shall have in India to *follow* the young growth with our main fellings rather than precede it as in Europe. But even in Europe there is often difficulty about regeneration, and the subject is capable of much useful discussion. We think the Methods of Treatment might advantageously have been dealt with at greater length.

In Chapter V we have much discussion on the principles of thinning, that subject upon which foresters differ so often. We gather that Dr. Nisbet is not in favour of the French system of leaving suppressed trees, because of the risk arising from fungi and insects and because the removal of suppressed trees leads to a better circulation of air. The French, however, lay stress on the protection given to the boles of the remaining trees and to the additional cover. We think that it is not perhaps sufficiently clearly brought out, that it is often necessary to reduce the congestion in a pole crop in order to help the trees of the future even when the crowns are all on a level. Dr. Nisbet has much to say against the vice of English forestry, over thinning.

In Chapter VI we find most of what is given on the subject of methods of treatment, but, as we have said before, the methods are treated as, in a sense, adjuncts of regeneration, instead of the other way about, and are but slightly dealt with. There is much of interest concerning the peculiarities of the various principal species in connection with their regeneration. The volume closes with a chapter on arboriculture.

This volume of "The Forester" is full of interest, and the style is so clear and lucid that it is easy reading. We hope it may effect its object and help forward the cause of forestry in England.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE GIR FOREST LIONS.

The following note recently appeared in a daily paper anent the lions of the Gir forest:—

"His Highness the Nawab Sahib of Junagadh having granted permission to shoot lions in the famous Gir forest, Colonel Kennedy, Agent to the Governor of Bombay in Kathiawar, with Lord Hawke, Captain Berthon and K. S. Ranjitsinghji proceeded in a special train placed at their disposal by His Highness from Jetalsar to Verawal *en route* for Lalala, one of the Gir centres, where a good camp had been arranged. *On March 2nd khabar was received at*

the camp of two lions, one lioness and two cubs lying in a nalla called Popatdi, and the party at once proceeded to that place and took up seats in a machan. A drive was organised *by which the animals ran past the machan* and both lions *fell to admirable* shots from Colonel Kennedy and Lord Hawke." (The italics are ours). "The party returned to Rajkot on Monday, the Agent alone halting here to see His Highness the Nawab. The shooting arrangements were excellent and were under the supervision of Nawabzada Sherjumakhanji, who is himself a good sportsman (*sic*). Last year eight lions were shot by different friends of His Highness."

Such is the account of the performance of men termed "sportsmen." The use of the word in such a connection is to be deplored. It is time that the attention of all true sportsmen was drawn to this question of the Gir lions. Instances are on record, plenty of them, of the extinction, within the period that man has occupied the globe, of various species of animals. Perhaps amongst the most startling and notorious of recent cases are those of the North American Bison (now almost extinct) and the African Quagga (supposed to be actually exterminated). The loss of these animals to the world, and the latter is one of unprecedented folly since the Quagga was the natural horse of South Africa, easily tameable and immune to the fatal horse diseases of the country, is entirely the result of the actions of such "sportsmen" as the Gir forest lion-slayers of the above paragraph. Blanford in the *Fauna of British India* states that "In India the lion is verging on extinction. There are a few living in the wild tract known as Gir in Kattywar, and a few more in the wildest parts of Rajputana, especially southern Jodhpur, in Oodeypur and around Mount Abu." In the seventies of last century lions were common near Mount Abu, several were shot near Gwalior, Goona and Kota and a few still existed near Lalitpur, between Saugor and Jhansi. One is said to have been killed near Goona in 1873. In 1864, one was killed near Sheora pur, 25 miles west of Allahabad; and when the railway was being made between Allahabad and Jubbulpore, in 1866, a fine lion was shot by two of the Engineers near the 80th milestone from Allahabad. About 1,830 lions were common near

Ahmedabad. Several years previously, in the early part of the century, lions were found in Hurriana to the northward and in Khandesh to the south, in many places in Rajputana (one was shot in 1810 within 40 miles of Kot Deji in Sind) and eastward as far as Rewah and Palamow. It is probable, says Blanford, that this animal was formerly generally distributed in North-Western and Central India.* Eastward and north of India the lion is not found, and almost the only part of Western Asia in which it is common is in Mesopotamia and part of South-Western Persia. There can be no two opinions on the fact that the lion has approached perilously near to extinction in India, and the question which faces and causes the gravest anxiety to the true sportsmen and zoologist is how to preserve the few which remain from the hand of the butcher. Sport in the killing of them there can be none. In the above account of the most recent "shoot" we read of two of the wretched beasts being driven, probably at a walk or trot, past the "sportsmen" safely ensconced in machans and falling to "admirable" pot shots. Lord Curzon set a good example a few years back by not only refraining from shooting any of the poor brutes but in refusing to be a party to or to countenance their slaughter. This example should, one would have thought, have proved sufficient for all sportsmen resident in the country. It is the ignorant globe-trotter, who is often far from what we in India term a sportsman, that has to be guarded against, and we trust the Government of India, after this latest example, will endeavour to take steps to prevent the extinction of such an interesting animal zoologically as the Gir lion.

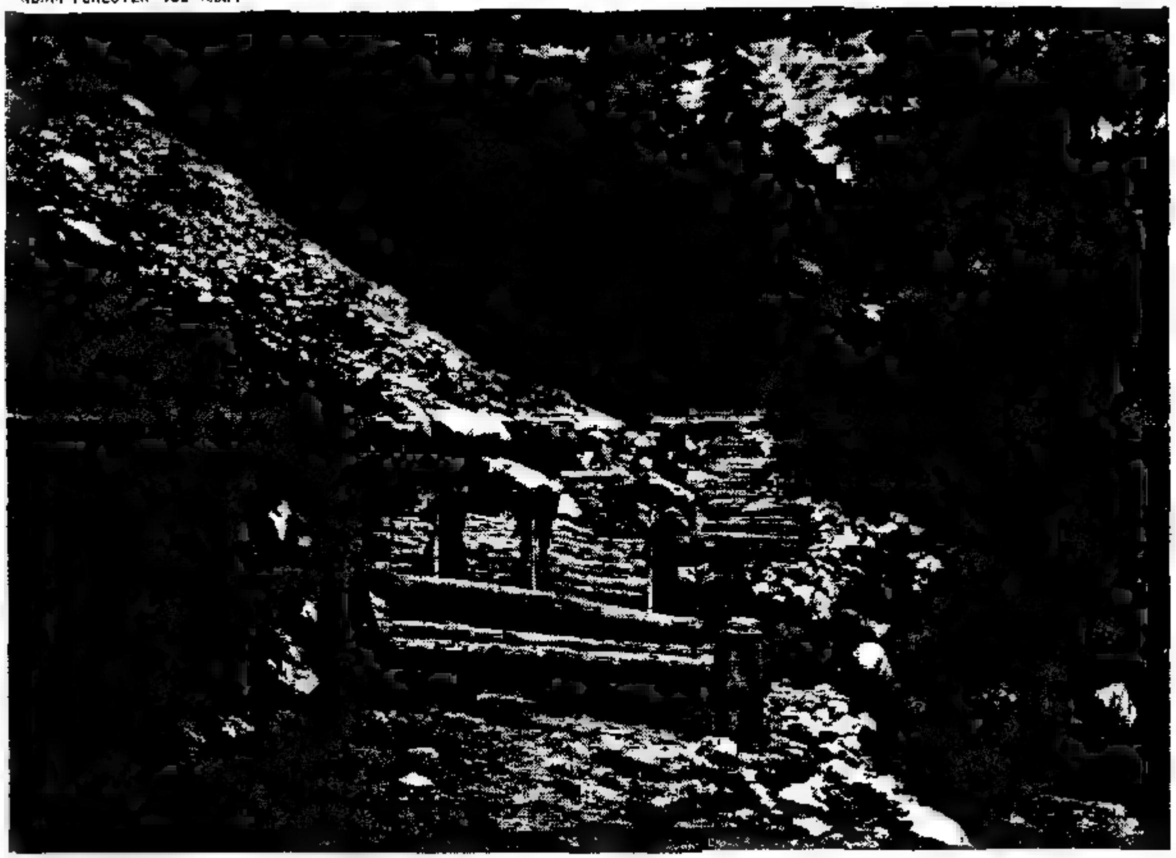

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by G. S. Hart.

A LOG-ROLLING ROAD IN BASHAHR, N. W. HIMALAYAS.

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FORESTRY TUITION AT OXFORD AND DEHRA DUN.

A study of the course of tuition laid down for the instruction of the probationers of the Imperial staff of the Forest Service at Oxford has suggested that a comparison of that course with the one given to the recruits for the Subordinate Executive Service at the Imperial Forest School, Dehra Dun, may prove of interest and, perchance, of use

THE IMPERIAL FOREST SERVICE.

We alluded recently to the fact that the entrance examination for those wishing to follow the Oxford course and obtain appointments in the Upper Controlling Staff of the Forest Service consisted of the subjects Mechanics and Physics, Chemistry, and Botany; the standard being the low one of the Preliminary Examination in the Honour School of Natural Science at Oxford. Candidates must have previously passed Responsions at Oxford or some equivalent examination. A qualifying examination in German is also included.*

* *Vide* Delegacy for superintending the instruction of probationers for the Indian Forest Service and for granting Diplomas in Forestry. Oxford Clarendon Press (1905)

The course of study at Oxford extends over a period of three years, and the probationer for the Department must attend all the lectures and obtain the Diploma of Forestry within the period. This Diploma is, however, granted to all members of the University who have—

(1) Pursued the approved course extending over two years.

(2) Undergone a course of practical work.

(3) Satisfied the examiners in the prescribed examinations.

THE COURSE OF STUDY

The following is the prescribed course of study :—

1st Year. Mathematics Chemistry of Soils and Organic Chemistry, Geology, Botany, Forestry (Sylviculture, and either Protection or Utilisation), Geometrical Drawing and Elementary Forest Engineering, German.

2nd Year. German, Geology of India, Botany (Pathology, structure of timber and special systematic botany), Entomology, Forestry (forest management administration, utilisation or protection), Forest Law, Surveying. Book-keeping in relation to Indian Forest Accounts.

We will consider these subjects briefly in detail:

1. *Mathematics* —Up to and including Plane Trigonometry.

2. *Chemistry.*—(*a*) Soils—constituents, origin and formation, classification, properties. *Physical and chemical analyses.* Exhaustion and restoration of soils. (*b*) Organic determination of composition and molecular weight of organic bodies. Laws of isomerism. Method of formation and general reactions of various substances. Outlines of vegetable chemistry.

3. *Geology* (*1st year*). Morphology and Physiology of the earth. Volcanoes, hot springs, earthquakes, mountain-building and dislocations. Development of earth. Scenery, structure and history of the British Isles. Fossils as a means of identification of strata Economic application of geology. (*2nd year*).—A course on the geology of India will be given

4 *Botany* (*1st year*) Physiology. General Morphology and Anatomy of Fungi and Vascular plants. Classification. Candidates

should also attend the general course given by the Sherardian, Professor of Botany. (*2nd year*).—Pathology including diseases and injuries caused by fungi and other plants. Special botany of timber trees. Systematic botany of Indian trees, shrubs and other forest plants.

5. *Forestry* (*1st year*) (*a*) Sylviculture—Foundations of sylviculture. Locality in relation to forest vegetation. Development of forest trees. Character and composition of woods. Sylvicultural systems. Formation and regeneration of woods (preliminary works direct sowing, planting, natural regeneration). Tending of woods (pruning, thinning) Sylvicultural notes on forest trees. Practical work in forest garden, Baghley wood and other excursions. (*b*) Forest Protection. Protection against man. Boundaries. Forest offences and rights. Protection against animals and plants, atmospheric influences, and against water, avalanches, shifting sand. (*c*) Utilisation Harvesting, conversion and disposal of wood and minor forest produce. Auxiliary Forest Industries (antiseptic treatment of timber, saw mills, wood carbonisation, extraction of oil of turpentine and resin, preparation of tannin and paper materials, &c. (*2nd year*). Forest Management (Mensuration, valuation, foundation of forest working plans (working scheme) preparation of working plans). Administration (utility of forests, the state in relation to Forestry, Forestry in the British Empire).

The text-books are Schlich's Manual of Forestry.

6. *Geometrical Drawing.*—Construction of scales and reduction of areas; use of instruments; preparation of plans, &c.

7. *Forest Engineering.* (Based principally on Indian practice.) Use, characteristics and manufacture of materials. Road construction, type designs of small bridges, culverts, bungalows. Timber slides, tramways, wire rope bridges, &c.

8. *German.* A Public School course in this language.

Note.—French is omitted.

9. *Entomology.* Outlines of elementary Zoology. Hydra Lumbricus. Study of anatomy, &c., of an insect type.

Classification of insects, metamorphosis. Diseases and enemies, relationships. Other Arthropoda of importance.

Note.—The Vertebrata are left untouched.

10. *Forest Law.*—Indian Penal Code, Criminal Procedure Code, Evidence Act, Forest Law of India.

11. *Surveying.*—Vernier and Sextant, Plotting and Computation of areas. Mapping, topographical details, conventional signs, colouring and finishing of plans. Prismatic compass, levels, theodolite, chain surveying, traversing, plane tabling. Abney's level.

12. *Forest Accounts.*—As required by the Forest Service.

THE PRACTICAL COURSE.

This course comprises nine months from the early part of October to the beginning of the following July. For seven months the students are placed with selected German Forest Officers, the remaining time being passed in visiting specially selected districts and forests. We shall allude later to this part of the course.

EXAMINATIONS.

There will be two examinations (partly written and partly oral) for the Diploma.

The subjects of the first examination are Botany, Geology, Entomology, and of the second Forestry, theoretical and practical, including sylviculture and protection, utilisation, management and administration. A candidate at the final examination must present certificates showing that he has attended approved courses of instruction in 2, 3, 4, 5, 6, 7, 9, 11; satisfy the Delegates that he possesses a sufficient knowledge of Mathematics and has passed examinations approved by them in Organic Chemistry and in Surveying.

Probationers for the Forest Service must also satisfy the Delegates that they have a sufficient knowledge of the Geology of India, Indian Forest Accounts and Forest Law. A candidate for the second examination must have passed the first one and present certificates showing that he has satisfactorily completed the prescribed course of Practical Instruction in Forestry.

The examination will be held about September 20th in each year

THE SUBORDINATE EXECUTIVE SERVICE.

In an article in this Journal last month it was shown that the upper grades of the Subordinate Executive Service received their Forest education at the Imperial Forest School at Dehra Dun. The Subordinate Executive Service is the Service from whence the Provincial Service is recruited and the students at Dehra are candidates for the former Service only. Two courses are given at the School, one in English and the other in Hindustani. We shall only consider here the course followed by the Upper Class in English. It may be remarked, however, that the utility of the lower vernacular course is open to considerable doubt, since it can only be delivered in one vernacular and is consequently only available for natives of the northern parts of the Continent. In a country like India, where the languages vary with the races, this fact from the first depreciates the value of the course.

The English course lasts 23½ months and the students are prepared for a certificate in Forestry by the Higher Standard.

THE COURSE OF STUDY.

The following are the subjects taught in this course:—

Forestry (sylviculture, utilisation, forest working plans, both theoretical and practical), Mathematics (elementary), Physical Science (Chemistry, Physics, Physiography, Geology, Mineralogy and Soils), Botany (theoretical and practical), Zoology, Drawing, Surveying, Forest Engineering, Forest Law and Forest Accounts and Procedure.

Taking these subjects in detail we find that the lectures delivered by the Instructors and the standard required from the students at Dehra Dun compare not unfavourably with the present course prescribed for the Imperial probationers at Oxford. Considering the subjects in the order already given above—

1. *Mathematics*.—Is practically identical with that required for the Imperial Service.

2. *Chemistry*.—A general course is first given, the lectures being accompanied by experiments conducted by the lecturer (who is a professional chemist). No practical work is done by the students themselves. This is followed by lectures on soils on the

lines of those delivered at Oxford. A course is also given in Elementary Physics.

3. *Geology.*—Physiography, &c., on the lines of the course given at Oxford Particular attention is paid to Indian Geology and the distribution of the fauna and flora. Mineralogy is also dealt with.

4. *Botany.*—Morphology and Anatomy. Physiology. Wounds and diseases. Classification. Geographical Botany. Indian Trees Chief classes of Indian forests.

5. *Forestry* (*a*) Sylviculture. Constitution of Forest. Climate and Forest. Soil and effect on growth. Composition of forests. Economic constitution of forest. Sylvicultural systems. Working of forests. Protection against climate, animals and plants, fires, &c. Artificial crops. Direct sowing, planting; artificial forests. (*b*) Utilisation —Properties of wood and their classification for sale. Wood industries. Tools, felling and conversion, disposal and sale of wood. Minor forest produce. Regulation of hunting, shooting and fishing. Mineral products Minor Forest Industries (manufacture of charcoal, cutch, distillation of sandal wood oil, resin, and turpentine, impregnation of timber). (*c*) Working plans (general principles, field work required in connection with their preparation; preparation of plans for various forest systems, working plan report).

6. *Geometrical and Freehand Drawing.* The course is practically identical with the one given to Imperial students A course of estimating is also given.

7. *Forest Engineering.*— Much the same course as given to Home students, but probably a more practical one. Building materials. Building. Road-making. Bridges. Transport of timber. Construction of wells Water and river bank works. Demarcation.

8. *German* —Not given.

9. *Forest Zoology.*—Elementary biology, systematic review of the animal kingdom with detailed descriptions of those groups of importance in Forestry. Anatomy of insects. Classification. Detailed accounts of families important in Indian Forestry. Life

histories of noxious and useful insects. Anatomy of Vertebrata Classification. Noxious and useful animals in Indian forests. Damage done. Practical work.

10. *Forest Law.*—General Law. Forest Law of India. Criminal Law applied to protection of forests and their produce in transit. The Forest Service (Nature, appointment of officers, responsibilities, protection of officers by law; offences and legal powers of officers).

11. *Surveying.* A theoretical and practical course is delivered on the lines of that at Oxford. The practical course is eminently satisfactory.

12. *Forest Accounts and Procedure.*—General Principles of Book-keeping. Cash accounts. Forest procedure and yield returns. General procedure.

THE PRACTICAL COURSE.

Before joining the School each probationer must undergo a course of some months' work in the forest under a Divisional Officer. The practical course at the School is of considerable length, about two thirds of each year being spent in camp, *i.e.*, 1st year, from 15th April to 15th June in hill forests; 1st November to end of March in plain's forests; 2nd year, from 1st April to end of May on a lengthy tour in the hill forests again, and November 1st to end of February in the plain's forests in the United Provinces and Punjab. As we shall see this course compares very favourably with that given to the Imperial Officers, it being remembered that it is passed *under Indian conditions.*

EXAMINATIONS.

The examinations are of two kinds:—

(*a*) Monthly to test progress; (*b*) Final.

The monthly examinations are held on the last two working days of each month, the finals being held in March of the second year.

The certificates obtainable after the final examination are a "pass" and an "honours" certificate. The former is granted to

students who obtain over 50 per cent. of the aggregate marks allotted to all subjects (this must include 50 per cent of marks given for each of the subjects Botany, Forestry, Surveying and Engineering). The honours certificate is given to students who obtain over 75 per cent. of the total marks, including over 50 per cent in each individual subject. These certificates are only granted under the orders of the Board of Control.

GENERAL REMARKS.

The above brief résumé of the two standards will, we think, suggest to the minds of our readers that the course given at Dehra compares satisfactorily with that given at Oxford, our opinion being that the latter or at any rate the theoretical portion of it, requires stiffening up very considerably. In some ways the Dehra course is perhaps superior to the Oxford one. Undoubtedly the greatest advantage possessed by the Indian forest subordinate is that he is trained in the country in which his future work is to be carried out, that he becomes acquainted in his practical course with forests of a similar nature to those in which he will have in future to work, and is thus the sooner able to apply the knowledge he has acquired in the lecture hall. For, instead of having his mind steeped in minute and precise, and perchance narrow and crystallised, methods of forestry, applicable and peculiar solely to highly civilised small States, he is from the first placed face to face with the larger areas and wider interests in which forest conservancy has to be practiced in India; he learns the difficulties which confront the Forest Officer in dealing with ignorant native races; he recognises that innumerable rights will have to be defined and treated with circumspection; and discovers the difficulties that exist in growing and extracting his timber, and in collecting and disposing of minor produce, &c., &c.

To the Home-trained probationer these aspects of Indian Forestry remain practically an unopened book, for without a knowledge of the present conditions of the country he must find it difficult to attach the proper relative importance to what may be detailed upon the subject in the lecture room and impossible to

BURMA

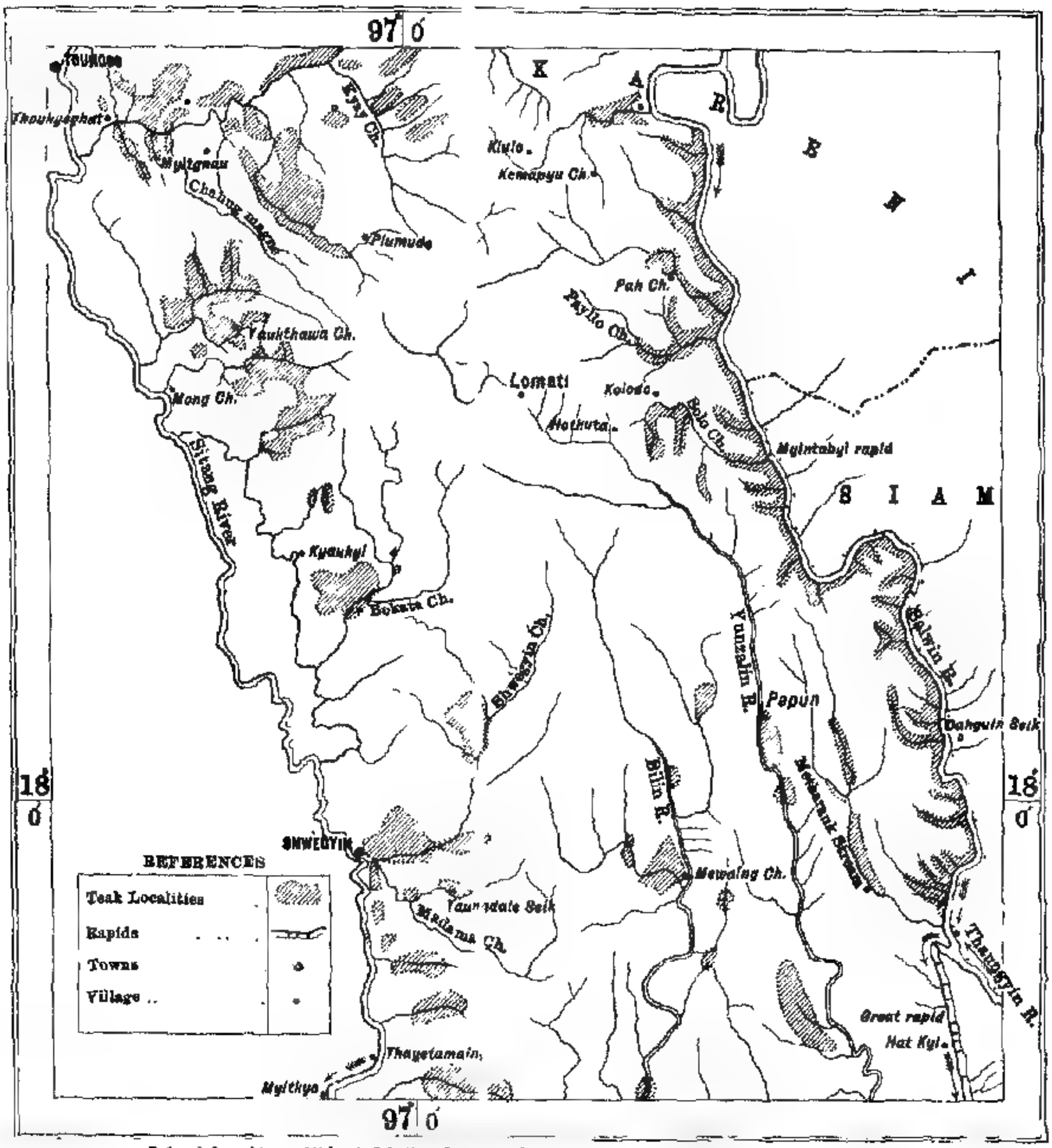
SKETCH MAP

Showing

TEAK LOCALITIES in MARTABAN

between

SITANG and SALWIN RIVERS



Reduced from Map published in Selections from Records Government of India Foreign Department XXIX 1861

Miles 10 5 0 10 20 30 40 Miles

Scale 1 Inch = 16 Miles

apply his theoretical knowledge in the absence of local experience!

In other respects the courses greatly resemble one another. In the Home course of tuition the student does not acquire a knowledge of Forest Zoology upon the lines most suitable for India, and he consequently arrives in the country ill-prepared to continue his studies there, while on the other hand much of the best work done under this head at present has been carried out by Dehra trained Forest Officers.

SCIENTIFIC PAPERS.

ON SOME BAMBOOS IN MARTABAN SOUTH OF TOUNGOO BETWEEN THE SALWIN AND SITANG RIVERS.

BY SIR DIETRICH BRANDIS, K.C.I.E., F.R.S.

In April last Mr. F. B. Manson most kindly collected for me in the vicinity of Papun specimens of ten species of bamboo, five of which were in flower. They reached me in November, too late for "Indian Trees," but some notes regarding them will be found under Addenda of that work. While examining these specimens it occurred to me that an account of the bamboos in this part of Martaban might be useful to some of my younger friends in Burma. The Teak forests in this part of the country I visited repeatedly in my early Burma days, and in 1861 I prepared a map of the Teak localities in Tenasserim, which I would recommend for reference. It was published in the selections from the records of the Government of India (Foreign Department No. XXIX, Calcutta, 1861), and a re-traced copy is appended to this paper.

The bamboos in the valley of the Yunzalin and on the hill between that river and the Salwin* were examined by me in March 1880, on my last tour of inspection in Burma, and notes regarding them will be found on pages 151—157 of my Report, entitled

* The spelling of the geographical names both in the Map and Memoir is that of the Author. We have not deemed it advisable to alter either. HON. ED.

"Suggestions regarding Forest Administration in British Burma, 1881."

Two remarkable species are found north of Papun, belonging to the genera *Phyllostachys* and *Thyrsostachys*. The former is No. 8 of Manson's collection, and the following remarks are mainly based upon the notes and specimens kindly sent by him. It was collected on the hills, generally close to streams, three days' journey from Papun. It is a small kind, single stemmed with creeping rhizomes but growing densely in fairly large patches, up to 50 acres in one place, sometimes among trees. Average height 12–20, some vigorous stems as much as 30 ft. internodes 5–9 in. long and 1 in. in diameter. It is used for making baskets and mats and the creeping rhizomes are prized for walking sticks, they resemble the so-called Malacca cane. The joints are used for the bowls of pipes, the stem being made of a small branch. A bamboo similar to this collected on Sinlum kaba at 6,500 ft. in the hills east of Bhamo (*Sadan*, Burm. *Sinwa*, Kachin) was sent me a few years ago, also in leaf only, by Montague Hill (No. 196), used for pipe-stems, internodes 8 in. long, diameter ⅜ in. Hill, however, does not say that it is single stemmed. **Phyllostachys Mannii* (*Maipang puk*, Shan, imported from China) is cultivated at Bernardmyo and at Shillong.

Phyllostachys is closely allied to the large genus *Arundinaria* of which many species are well known to foresters in the Himalaya, in the Khasi and Naga Hills. These two genera can easily be distinguished by the younger culms and principal branches being flattened or grooved on the inner side above the axillary bud and hence angular. The branches from each node are less numerous than in most species of *Arundinaria*, usually 2—3 only, and the uppermost leaves often in pairs, the internodes between these two last leaves being very short. Fig. 1 represents a small portion of a leaf of this species, the longitudinal nerves are 33 on ¼ in. and the transverse veins are very prominent, dividing the leaf into squares or short rectangles. Some species of *Arundinaria* (for

* The specific names are those adopted in "Indian Trees," hence I have as a rule omitted authorities.

instance *A. falcata*) have the transverse veins obscure, others (*A. spathiflora*) have the transverse veins prominent, but far apart, so as to form long rectangles with the longitudinal nerves.

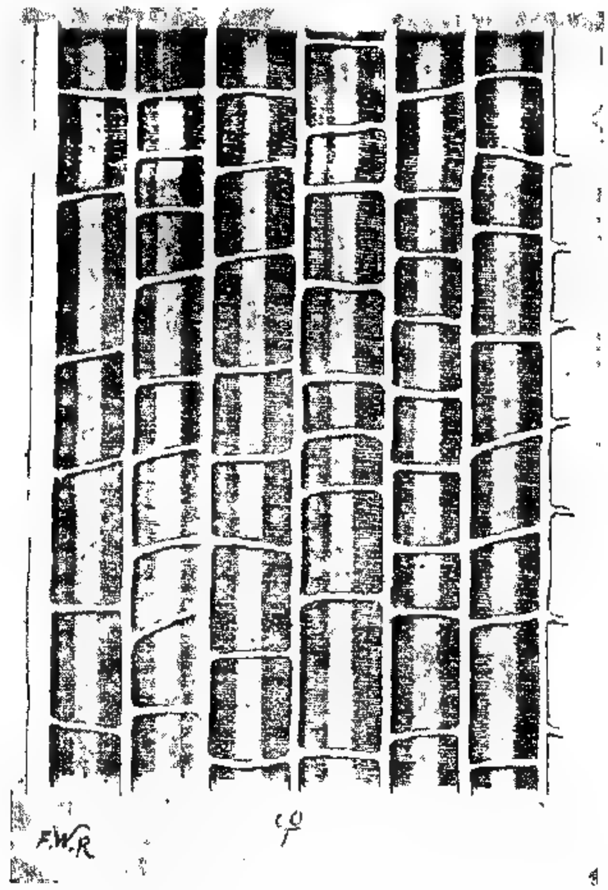


FIG. I. PHYLLOSTACHYS S.P.—Piece of leaf ($\times 60$) showing 6 fine and one stout longitudinal nerve (33 n. on $\frac{1}{4}$ inch) and the bright bands of the silica cells *alternating* with the nerves. Transverse veins conspicuous, straight, oblique or slightly bent, dividing the leaf into squares and short rectangles.

An *Arundinaria* with leaves similar to this species of *Phyllostachys* is *A. elegans*, discovered by Kurz on Nattaung east of

Toungoo at 5—7,500 ft. also known from the Naga Hills and which will probably be found elsewhere on the hills of Burma.

Thyrsostachys siamensis (*Ti wa*, *Ti yo wa*, Burm.) I found in May 1859 between the Solo and Kèmapyu Choungs. The Solo passes Kolodo and joins the Salwin river at the Myintabyi rapids. Thirty miles farther north a much larger stream, the Kèmapyu empties itself into the Salwin. This stream rises in the high mountains between Salwin and Sitang north-west of Khulo village, where at the time of my visit in 1859 the Karens were busy roasting and smelting the tinstone, large deposits of which are found on those hills. Between these rivers, not far from the Salwin I found the *Ti-wa* with Teak in the valleys of the small mountain streams, but not in the dry Eng forest, which occupies the high ground between these valleys. It is a most handsome bamboo, tufted, culms erect 25—40 ft. naked below, with dense half whorls of branches near the top, internodes 10—13 in. long, very uniform in length, diameter 1½—3 in., node rings horizontal, elegant. At that time it was said to be abundant in the Siamese territory east of the Salwin; and in Upper Burma this species is cultivated largely in Monastery gardens. It is well known as the best bamboo for umbrella handles, and in 1859 it was brought down in large quantities to Moulmein and Shwegyin. The leaves are small, 3—6 by ⅓—½ in. transverse veins obscure and longitudinal nerves 33—48 on ¼ in.

On 6th March 1880 I met Major (now General) Seaton near Hothuta on the Upper Yunzalin and in company with him examined the Upper Salwin forests on the head-waters of the Metharauk stream. After crossing the watershed between Yunzalin and Salwin, we found ourselves in the region of one of the gigantic bamboos known as *Wakhi* by Karens and as *Kyellowa* by Burmans, which was called *Bambusa Brandisii* by Munro and *Dendrocalamus Brandisii* by Kurz. It is No. 9 of Manson's collection. This, like many species of the same genus, flowers frequently, the heads of spikelets are glodose ⅓—½ in. diameter arranged at regular intervals in long spikes resembling a necklace. The leaves are large, the culm sheaths thick, coriaceous, with a long,

linear-lanceolate blade. I have measured culms 120 ft. high, the internodes are 20—27 in. long and 5—7 in. diam. This species is common in the lower Thaungyin valley, chiefly on limestone. I have also found it in the Attaran district and specimens have been sent from Upper Burma. It is similar to and perhaps identical with *D. flagellifer*, a Malay species, which Colonel Beddome found on the lower slopes of Muleyit hill at 2,000 ft. in Tenasserim. I may here mention that the home of the most important gigantic bamboo, *D. giganteus*, with large ovate spikelets, ½ in. long, which is cultivated largely in Burma and India, is not yet known with certainty. I am inclined to think that this species also may yet be found wild in the Martaban hills

In the Yunzalin valley are other species of the same genus, chiefly *Waya, D. longispathus*, a large species, the culms attaining 60 ft. easily known by very long, thin, but long-persistent culm-sheaths, densely clothed outside with black stinging hairs (Suggestions, pp. 155, 157.) *Myinwa*, (*D. strictus*) is found on dry limestone rocks in the Upper Salwin forests, but is less common in Martaban than in Pegu.

D. membranaceus, *Hmyin-byu-wa* Burm. *Wa-nyi*, Kar. (Manson No. 10). Like the common *Myinwa* this species has small leaves, the flowers are in dense globose heads consisting of numerous spinescent spikelets. In *D. strictus* the heads are hairy, in *D. membranaceus* almost glabrous.

Nearly allied to *Dendrocalamus* is the large genus *Bambusa*, of which three species are known to me from this part of Martaban; *Thaik-wa* (*B. tulda*), *Kyakat-wa* (*B. arundinacea*) and *Kyathaung-wa* (*B. polymorpha*) The chief distinction between these two genera is that in *Bambusa* the caryopsis has a thin, membranous pericarp, adherent to the seed, while in *Dendrocalamus* the seed is enclosed in a hard, crustaceous or cartilaginous pericarp. The flowers of *Dendrocalamus* as a rule have no lodicules, while in *Bambusa* the lodicules are prominent. (Fig. 2, *b*.)

Thaik-wa grows in the Sitang valley, elsewhere it is perhaps less common in Martaban than in Tenasserim, Pegu and Upper Burma. It is readily distinguished by the large, wavy fringed

auricles at the top of the culm sheath on both sides of the triangular blade, the palea is sharply acute, a little shorter than the glume, the lodicules are large and the anthers are bidentate at the tip.

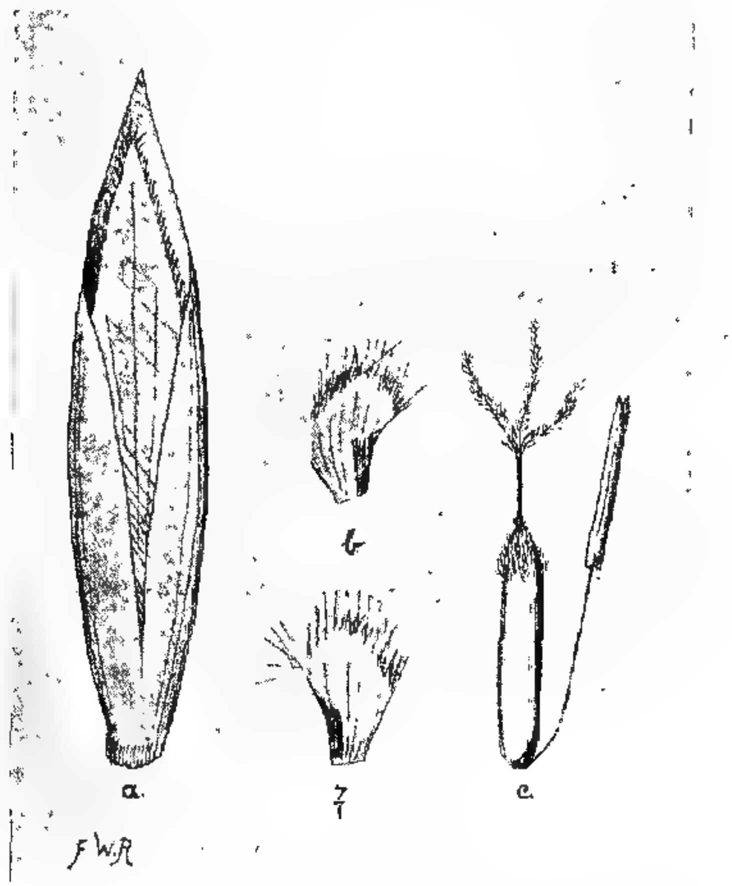


FIG. 2.—BAMBUSA TULDA, ROXB.—(× 7)—(*a*) Front view of glume and palea, the latter shorter. (*b*) Two lodicules, large and well developed in this species. (*c*) Ovary, hairy at the tip, style glabrous, with three densely papillose branches. Stamen, the anther emarginate at the apex.

(Fig. 2, *a*—*c*.) *Kyakat wa* is common along the banks of the larger rivers, for instance, on the S[illegible]n near the mouth of the Kemapyu Chaung.

Kyakat-wa is readily known by its spinescent branchlets, the culms closely packed in large clumps, not quite straight, but slightly zigzag at the nodes with thick walls. The culm sheaths are shorter than the internodes, coriaceous and prominently ribbed on the inside. The spikelets may at once be recognised by the palea slightly longer than the glume, densely set with long stiff hairs at the keel. (Fig. 3, *a*, glume, back, palea longer, tip visible;

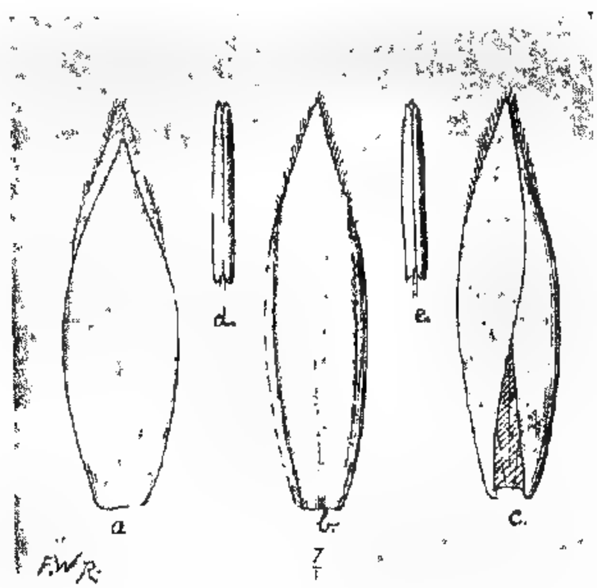


FIG. 3.—BAMBUSA ARUNDINACEA, WILLD.—(× 7.) (*a*) Back view of glume and palea, the latter longer. (*b*) Back view. (*c*) Front view of palea. (*d*) Anther, tips emarginate. (*e*) Anther, tips acute.

b c, palea back and front view.) The tip of the anthers varies. I have found them blunt or slightly emarginate in some, mucronate in other cases. (Fig. 3, *d*, *e*.) *Kyathaung-wa*, the most elegant of all Burmese bamboos, well known to foresters, is found in the Sitang valley on hilly ground, and, as stated on p. 151 of my Report of 1881, is associated with Teak in the Upper Salwin forests.

Thaik-wa at times flowers gregariously, while at other times single clumps will be found in flower. The two other species always flower gregariously, *Kyakat wa*, as far as known, at intervals in the same district of 32 years, while the length of the flowering period of *Kyathaung wa* is not yet known.

(*To be continued.*)

ORIGINAL ARTICLES.

SELECTION BY AREA

BY A. C. HOBART HAMPDEN, I.F.S.

It may be of interest if I describe a somewhat novel form of Selection that has lately been prescribed in a Working Plan.

Our usual plan in India in applying Selection is to make a partial enumeration of the stock, to divide the forest into the same number of coupes as there are to be years in the felling cycle, making these approximately equal, and then to calculate the maximum number of trees which may be felled annually.

It is assumed that by multiplying the number of trees on the percentage of the area enumerated by the total area of the forest the result will give sufficiently nearly the correct total number of the trees in the forest. In point of fact this is a very wild assumption, and in my experience nearly always wrong at times exceedingly so. In my opinion these partial enumerations, with a high forest method of treatment in view, are so much waste of time and money, and if enumerations are made at all they should be complete, and made for the three highest girth classes.

To equalise the outturn of the coupes, while keeping them of approximately equal area, the earlier numbers are put in the richer parts of the forest, and it is assumed that this will sufficiently nearly result in an equal annual outturn and render it permissible to safely apply our figure of annual maximum number of trees for felling. This again is obviously the very wildest of assumptions. It is done without calculation and purely on surmise, and that

being so how can the figure of trees prescribed for felling be anywhere near right for each coupe?

Either of these assumptions would be enough in itself to completely vitiate the figure of trees to be felled annually even though this figure is laid down for safety's sake as a *maximum*. But there are other assumptions also before this figure is arrived at.

The number of trees annually to be felled is arrived at by adding the whole of the trees that are mature to that proportion of the next class which during the felling cycle will enter the mature class, and dividing by the number of years of the felling cycle. (This is in cases where the girth classes are normally represented; when this is not the case the arrangement has to be altered, as is shown on pages 136 and 137 of D'Arcy's Working Plans).

To find the number of II class trees which in the course of the felling cycle will enter the I class (the lowest dimension of which is here supposed to be the size of maturity) the number of years which a II class tree of the lowest dimension will take to reach the size of maturity is found by reference to sample plot measurements. This is perhaps all that can be done, but it is to be noted that the rate of growth really varies all over a forest according to efficiency of protection, soil, aspect, density of crop, altitude, etc., etc., and may very well not be truly represented by the few individuals that it is possible to measure in sample plots. Moreover, it is exceedingly difficult to really properly locate plots which are true samples of the whole forest. My experience is that good crops are generally chosen for sample plots, and not average ones. There is therefore a very considerable possibility of error in arriving at the number of II class trees which will become exploitable in the course of the felling cycle.

In addition there is to be considered the proportion of II class trees which will fail to survive. For this we have nothing but assumption to go on.

It is thus the fact that when a Selection forest is to be worked on the basis of the number of stems to be felled annually there is

room for the very widest error. If the figure is placed too high we shall not find the number of mature trees present; if the figure is placed too low we shall have to leave (probably all at one end of the coupe) a number of trees which sylviculturally and economically ought to come out—*and this error is a vital one.* It is taken for granted that we must not take II class trees to make up our total; this, in my opinion, would be utterly inadmissible.

Assuming even that we had pitched on the right number of trees to fell annually the fact that there is also an area check (that of the coupe) will constantly put us wrong, for if in one coupe we find less mature trees than may annually be taken, the balance of trees must by the hypothesis, be elsewhere. Yet we are unable to take them when we do find them in another coupe, because the annual figure for felling is a maximum. To be consistent a Selection forest worked on the basis of stems should have no area check.

On the other hand if—as in the case of the Working Plan to which I am referring—we confine ourselves to prescribing that all the mature trees found in the coupe are to be removed, and at the same time adjust the areas of the coupes in such a manner that in each year we shall find an approximately equal number of mature trees present, we cannot go far wrong. Even if our coupes thus formed do not in fact turn out to have in them, at the time of felling, an equal number of mature trees, the error is not a vital one, such as a sylvicultural error would be.

Exception is sometimes taken to coupes varying considerably in size. Yet I cannot see why; a coupe does not need to be a fixture-block and compartments give all that is required in the way of permanent divisions in a forest.

The problem, then, lies in the differentiation of our coupes. To arrive at this satisfactorily the enumeration of the highest three classes of trees must be carried out completely and *localised,* that is, recorded separately for separate areas, in which of course there is no difficulty. The enumeration compartments must be small, so as to enable us to tell how the stock stands from point to point

throughout the forest. In each small compartment we learn the number of mature, of II, and of III class trees standing, and we thus obtain a true picture of the forest at the time of enumeration. In laying out the boundaries of the coupes from this information it is necessary to work with two of the assumptions of the ordinary form of Selection. These are the number of years it will take a II class tree of the smallest dimension to enter the I class, and the percentage of II class trees which will not survive to become I class, but if either of these assumptions turns out to be wrong the result is not a sylvicultural error—it is merely an error in the figure of annual outturn available. Moreover *these errors can be corrected in a short time by prescribing*—as has been done in the Working Plan which is in my mind—that, after say ten years, one or two compartments just about to be felled shall be re-enumerated, and compared with the statement for these compartments as it was calculated they would be at the time of felling. We may even dispense with this enumeration and simply compare the actual result in trees felled in the various compartments with what it was calculated they would contain at the time of felling. In the light of the error discovered the boundaries of the remaining coupes of the cycle can be readjusted, if necessary, so as to produce an approximately equal outturn.

By adding the number of mature trees in the forest to the II class trees which will become mature during the felling cycle, and dividing by the number of years of the cycle the annual number of trees available is found. The direction of the fellings will be from the richest part of the forest towards the poorest. Coupe I is then laid down from a consideration of the enumeration of the trees in the (small) enumeration compartments. The other coupes follow, it being always remembered that the number of the coupe gives the number of years that will have elapsed since the enumeration—and that accordingly that number of years growth must be added to the II class trees enumerated on the area in question in order to find how many of them will have become mature in the year for which the felling is fixed.

For example, our annual number of mature trees for felling is, say, 2,200. We are dealing, say, with Coupe VIII, and the areas adjoining Coupe VII (already laid down) are:

Block K. Cpt. I, in which there are 1,132 I class trees and trees of the II class which will to the number of 125 have become I class in the 8th year.

Block K. Cpt. 2	...	*nil*	(I class)	...	*nil*	(II class)	
" " 3	...	74	"	...	18	"	
" P. Cpt. 4	...	140	"	...	14	"	
" " 3	...	480	"	...	54	"	
Total	...	1,826			211		2,037

There is thus a deficit of 163 trees to be made up.

The adjoining area is Block P. Cpt. 2, and it contains 465 I class trees and 79 II class trees which will be mature in the eighth year, total 544. As, however, we only require 163 trees to complete the coupe we arrive at the number of acres of Block P. Cpt. 2. to be added by dividing 163 by 544 and multiplying by 157 (the area of Block P. Cpt. 2). This gives 47 acres, and 47 acres of this compartment are accordingly added to make up Coupe VIII.

This may possibly seem complicated, yet it is not really very much so, and it will be found comparatively simple to distribute the total number of trees to be felled during the cycle through the area of the Circle. Note that the enumeration compartments can be as small as we like—they have only to be laid down on a map and natural or artificial features are generally available in any quantity, while even if they are not, as in a forest on a flat, correct measurements can be easily laid down on a map.

Of course it may be objected that some of the mature trees will have to be left for seed-bearers, there not being always at hand other seed-bearers of lower classes. This, however, would not amount to much, and it would apply, more or less, alike to all coupes. As a matter of fact in the Working Plan which is in

my mind this is not a difficulty, because it deals with a Deodar forest in which it has been found by experience that reliance cannot be placed on natural regeneration, since the only result of fellings is, as a rule, not a young crop of Deodar but an impenetrable growth of weeds. As, then, artificial regeneration, has been shown by experience to be, in that place, both successful and inexpensive the Working Plan deliberately prescribes the removal of all mature trees and their replacing by artificial regeneration wherever required.

It will be recollected that we have been dealing with an example of a forest in which the age classes are fairly well distributed as shown by the enumerations, but in order to be sure of this it was necessary to enumerate the III class, as well as the I and II. Should the I class be in excess, or the II class in deficit, various adjustments may become necessary, but for our present purpose the comparison of ordinary Indian Selection with this special method it is useless to consider this; it would be no more difficult to apply such adjustments to this method than to ordinary Selection.

In the enumerations for the Working Plan which has served as the basis for these remarks it may be noted that far greater accuracy than usual (in regard to the number of trees passing up from one size class to another) was assured by the simple plan of dividing the colour classes on the calipers by white lines into three sub-classes, with one, two and three white dots respectively in the three divisions.

This method of treatment might suitably be called "Selection by area" not that "Selection" is a good word, but it is at least understood by foresters, and a substitute is difficult to hit upon. It is claimed for the method that it is not based on so many assumptions as ordinary Selection, that such assumptions as it does make use of can be easily corrected at short intervals, and that even if its single aim (an approximate equal annual outturn) is not, after all, achieved the error is of no great importance, while sylvicultural errors (from which it is free) are very much so.

C. C. HATT.

The death of Mr. C. C. Hatt, Deputy Conservator of Forests, which took place at Rajabhatkhawa, in the Buxa Division, on the 14th January 1906, has deprived the service of one of its most capable officers and many of us of a true and valued friend. Hatt joined his appointment in India in 1891, and served in Bengal till the formation of the new Province of Eastern Bengal and Assam to which he was transferred with his Division. In the early part of his service he chiefly distinguished himself by his work including the preparation of first working-plans, in the Puri Division and in a neighbouring State, Mohrbanj, to which he was deputed for nearly two years. A severe attack of cholera obliged him to take furlough from 1900 to 1901, and after his return he undertook the preparation of first working plans for the Kurseong and Buxa Divisions. To this difficult task, and the development of the Buxa Division of which he held charge for the greater part of the time he devoted the whole of his energy, regardless of the exposure in very unhealthy tracts which was a necessary part of the work; and his working-plans, of which the last was finished only a short time before his death, will be durable monuments to his zeal and capacity. His devotion to his profession did not prevent his taking an active interest in manly forms of sport. He played football for his county and for Cooper's Hill, and was one of the best bats in the Cooper's Hill cricket team of his time; and in recreations, as in work, he endeared himself to his associates by his unselfish keenness and modesty.

FELLING WORK IN BASHAHR, N.-W. HIMALAYAS.

BY G. S. H.

The felling of large trees uphill on steep and difficult slopes is often held to be dangerous and no doubt it is extremely so without the aid of ropes to assist in directing the fall of the stems; but where a man can be got to go up the tree, lop the main branches and fix a rope in the upper portion there is no danger to speak of and the success of the operation should be certain.

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by G. S. Hart.

DEODAR, 15 FEET GIRTH.

Felled up hill with the aid of ropes; butt resting on stump.

Of course it is necessary to place the cuts properly, that is, for the cut on the uphill side to be taken well past the centre of the stem and for the cut on the opposite side to be brought down on to the former from a slightly higher level, while the bases of both cuts must be kept approximately parallel to each other and at right angles to the axis of the stem and to the direction in which it is desired that the tree shall fall. If this is done the tree, just before falling, rests on a long wedge and it is almost impossible for it to fall except as desired or in the opposite direction. The men at the end of the rope see to this, and as it takes a long strong pull to bring the tree over there is always plenty of time for the axemen to get clear. The butt of the stem felled should remain on the stump end; in the majority of cases it does so; but where it jumps from the stump the whole stem goes down hill end on, and does little damage either to itself or to standing trees. The photograph (Plate XV) shows a tree of 15ft. girth felled as described in the Sakalatpa forest of the Pandrabis Range. The ground is particularly bad, so much so that although the forest is situated within three miles of the Sutlej river and, up to the year before last, had never been touched, no fellings were proposed in the first working plan. The average girth of the trees cut in this forest was a little over nine feet, and the average cost of felling was about one rupee a tree, that is to say, about 2½ times as much as the cost of felling without branching and without the use of ropes; but the extra cost was nothing compared to the loss that would have occurred under the latter method. No serious accidents have occurred in the fellings either in this forest or elsewhere, though a very large number of trees have been felled in this way in Bashahr.

There is so much sawing work now in the more accessible parts of the hills in the Punjab and United Provinces that it is difficult to get a sufficient number of sawyers to come to Bashahr. The best men we get come from the neighbourhood of Datapur in the Hoshiarpur District and, as is shown in the photograph of "Sawyers at work", Plate XVI, three of these men work together at one saw. One such "Jori" does a good

deal more work than two pairs of hill sawyers. The two remaining photographs show rolling roads in connection with the extraction of logs from the Panwi forest in the Paranda Range One of them, Plate XIV, shows an ordinary rough rolling road on an easy hillside, but the other, (XVII), is unusual for it represents the bed of a stream transformed into a rolling road. The last bit of ground leading down to the river was such that neither rolling road, shoot nor slide could be constructed, and so there was nothing to be done but to clear out the bed of the stream, lay down poles and roll the logs down to the Sutlej The work of propelling the logs along these roads looks easy enough, and it would seem to be far less dangerous than the job of felling trees uphill. Yet fatal accidents on the log roads are not very uncommon The heaviest logs go first occasionally and the workmen omit to support the leading log sufficiently One unfortunate steps on to it and starts it off, with the result that he is thrown in front and, well, more or less flattened out.

THE FORESTER

BY JOHN NISBET, D.ŒC.

II

PART IV.—PROTECTION OF WOODLANDS

The protection of woodlands is the oldest branch of Forestry. It deals with the methods by which damage to timber and other woodland crops can be prevented or remedied. Woodlands require to be protected against injuries caused by men, farm live-stock, game, other animals (vermin), destructive birds, injurious insects, weeds, parasitic plants and inorganic agencies. Dr. Nisbet deals with these various dangers in this order.

Chapter I. of this part deals with protection against men and human actions. It is pointed out that, without special legislation, individuals would be practically powerless to preserve their forest tracts from injury. In India, France, Germany, etc., there are special forest laws for protecting woodlands against injury. In Britain there is no necessity for such since human actions affecting proprietory rights in woodlands are controlled by the ordinary civil and criminal law. In this connection boundary marks, commonage and rights of user (practically) confined to the crown forests, theft and mischief, trespass and fires are considered. Dr. Nisbet advocates the planting of wide belts of broad-leaved trees (*e.g.* Birch or Rowan in Scots Pine tracts) along railway lines passing through coniferous forests, the ground below the belt being kept free of inflammable material to a breadth of about 20 yards. Extensive Scots Pine areas should be divided into moderate sized compartments by narrow rides, kept free of inflammable matter. The various ways of extinguishing fires are dealt with in detail.

Chapter II deals with the protection of the forest against live-stock, game and the larger kinds of *vermin*.

Farm live stock, consisting of cattle, horses, sheep goats and swine, cause damage to woods by nibbling buds, leaves and young shoots; by gnawing and stripping young bark, by injuring roots with their hard hoofs and horny feet; by keeping back young growth and *saplings; by dislodging soil* on slopes, by stamping down damp, heavy clay soil and loosening light sandy soil, and by breaking down the sides of drains. The damage done of course varies greatly according to the kind and number of animals present; these are classed by the author in the following order: *goats, horses, sheep, cattle* and *swine*. Sheep and cattle, we are told, are, however, by far the most important in Britain. The damage done by these animals is considered in detail, the chief remedy advocated being fencing.

Turning to game and the various ways of reducing or preventing its destructiveness in woodlands, Dr. Nisbet points out that in British rural economy more attention is generally given to game preserving than to Forestry and usually a higher rental is received from shooting tenants than is otherwise obtainable. Game preservation, as customary on most large estates in Britain, is incompatible with profitable Forestry; and where rabbits are allowed to abound it is almost impossible that woodlands can ever show anything but *a dead loss*, properly chargeable to the game account. "There is only one form of British sport (*sic*) which is really of some advantage to the woodlands and that is the preservation of foxes which help to keep down rabbits and hares. All other forms of game preservation tend to disturb the balance of nature and result in damage to the woodlands. Planting operations cost much more owing to ground game not being kept down to a greater extent. Dr. Nisbet shows that sport and Forestry are not necessarily antagonistic; on the contrary they are closely related and may be easily combined with profit. There is *less shooting* but more *sport* in the true sense of the term in the large forests of Continental Europe than is obtainable anywhere in Britain. The wild boar, red deer and roebuck shooting is more sporting in

continental forests than in the so-called Deer forests of Britain which are only heathery wastes, and the antlers of the forest-bred, stag are far heavier and handsomer. The existing Highland Deer "forests" might therefore be planted up without any danger of ruining the sport obtainable. Red deer and roebuck, hares and rabbits and feathered game all injure woodlands to a greater or less extent. The author considers in detail each of these animals, mentioning the trees affected, kind of damage done and methods of preservation. In this latter connection in addition to methods for protecting individual trees the question of fencing is dealt with in a particularly lucid manner. Wire fencing, the different ways of putting it up and the cost, wood fences, dykes, mounds, etc., are all considered in full, the excellent illustrations serving to make the author's remarks perfectly clear.

The chapter next deals with those pests of the Forester, the smaller rodents or vermin (squirrels, mice and voles). The various British species are described, their habits detailed and methods of prevention and extermination dealt with.

Chapter III is devoted to the protection of woodlands against destructive birds. Although on the whole much lighter than the damage caused by insect enemies, or even in many cases than that resulting from deer and ground game, the damage done to woodlands and nurseries by birds is occasionally by no means inconsiderable. On the other hand, many species of carnivorous birds are of decided utility by feeding on small ground vermin and insects, others are useful at one period of their existence and harmful at another, whilst others again are directly harmful.

Birds useful in keeping down ground vermin are the buzzards, stannel hawk, various species of owl, rook, carrion crow, hooded crow, jackdaw and some of the hawks. Amongst the birds decidedly useful in preying upon injurious insects are the cuckoo, starling, tits, swallows, warblers, nightingales, wrens, wagtails, owls, nightjar and gulls. More useful than injurious are sparrows, finches, larks, woodpeckers, thrushes and blackbirds, jackdaws, rooks and crows, common buzzard, lapwing or green plover and peewit. We are of opinion, however, that the

woodpecker is often most harmful in the forest. More injurious than useful are certain finches, the house sparrow, shrikes, magpie, eagles hawks and falcons. Our author divides the decidedly injurious birds into four classes—grouse, pigeons, jays, finches. These he considers do very appreciable damage in woods and nurseries. As pointed out by Dr. Nisbet the protection of useful birds cannot be too strongly insisted upon.

Chapter IV treats of the protection of the forest against injurious insects, and here we find that the author is by no means so happy with his subject as elsewhere. Excellent though much of the 80 odd pages devoted to this part are, they would have proved more valuable and more in keeping with the other portions of this excellent work had Dr. Nisbet submitted them, even in proof form, to the eye of one having an acquaintance with the subject. It is impossible nowadays for any man to be, or even pretend to be, a specialist in many subjects, and without the necessary technical knowledge more harm than good results from putting pen to paper. Our author commences with what he terms the "Life History of Insects" under which he describes their external structure and development. The classification adopted will prove, perhaps, useful to those interested in archaic records but appears curiously out of place in a twentieth century work. With such volumes as Sharp's "Insects" in the Cambridge Natural History Series, a commonly accepted British classification (to mention but one out of many), as a guide, it is difficult to understand how a man of our author's calibre and carefulness could turn to and repose faith in the works of his childhood's days. We regret that it is impossible to consider this part of the book anything but antiquated and in several places misleading. For example, to note one instance, he calls the various species of *Tomicus* (*Fam. Scolytidæ*) mentioned "*Bostrichus*," grouping them under "*Bostrichini*" (p. 50)! On p. 84 he calls *Tomicini* a synonym of *Bostrichini* and includes the genera *Tomicus*, *Xyloterus* and *Xyleborus* all under *Bostrichus*. When it is pointed out that the *Bostrichidæ* are a totally different family of beetles of which *Bostrichus* is one of the oldest genera, and that, although

many are wood feeders, none as far as is at present known are cambial feeders, the confusion arising from the above treatment will be understood. The division of the bark-beetles (or true *Scolytidæ*) into sapwood beetles, cambial beetles, and true bark beetles, (whatever this latter may mean) is as misleading as it is unfortunate, since the terms applied to these divisions will strictly hold for neither. It is unnecessary to touch here upon such minor inaccuracies as calling the Dung beetles (*Coprides* *Staphylinidæ* or the inclusion of the *Cleridæ*, which are termed "gold beetles," under the *Malacodermidæ*, etc. Turning now to the manner in which the insects are dealt with we find, near the commencement, a table, arranged according to the classification adopted, giving a list of species to be alluded to under each order. Each order is then taken seriatim and briefly described, as are also the families including injurious species. These latter are then taken individually, a brief description given, followed by a short life history and methods of prevention. Excellent illustrations enable one to make oneself acquainted with the various pests described. This portion of the chapter, whilst capable of a different and, we think, a more adaptable treatment, follows the well-known line adopted by all writers upon this subject and has much to commend it.

Chapter V is devoted to a consideration of methods of protection against weeds and parasitic plants and here we find the author quite at home again. He points out that plants of various kinds may interfere with the growth of timber crops either by overrunning the soil as *weeds*, overtopping seedlings and plants in young plantations or else as *epiphytes* or as *parasites* and *fungi* on or in trees and frequently causing disease. Fungous diseases, it is said, often epidemic, always damage buds, leaves, roots or timber of trees attacked and may cause the death of single trees or large blocks of timber. Fungus diseases, it might have been added, often follow the attacks of injurious insects.

Dr. Nisbet first considers weeds under which he includes all vegetation interfering with the vigorous growth or regeneration of timber crops. He points out how natural regeneration is impeded or prevented, how young seedlings are killed as a e

also transplants by the more rapid growing weeds. He divides the more important weeds into four groups according to the nature of the soil they frequent.

(1) On wet boggy or peaty soil: Sphagnum, Polytrichum, Erica, Vaccinium, Pedicularis, Rumex, Eriophorum, Equisetum, Carex, Scirpus and Juncus.

(2) On fresh fertile humose soil: Rubus, Rosa, Digitalis, Epilobium, Atropa, Solanum, Urtica, Trifolium.

(3) On dry loam and sandy soil:—Calluna, Vaccinium, Ulex, Sarothamnus, Genista, Senecio, Verbascum, Hieracium, Euphorbia, Carex, Elymus, Agrostis, etc.

(4) On salt soil: Salicornia, Salsola, Plantago, Glaux, etc.

Amongst shrubs found on fresh soil amongst hills and valleys are Cornus, Rhamnus, Prunus, Crataegus, Euonymus, Viburnum, Berberis, Ilex, Lonicera, Ligustrum, Sambucus.

Weeds are of importance since they not only give a general indication as to the nature of the soil but also to a certain extent indicate its physical properties. Various methods for the prevention and extermination of weeds are given.

The epiphytic plants are next considered, the chief being Ivy, Beard mosses, Usnea and other Lichens. The small climbing plants such as Lonicera, Clematis, Convolvulus and Humulus are also noticed.

Under parasitic plants Viscum and Cuscuta (more harmful to field crops than to nurseries or plantations) are discussed, the rest of this interesting chapter being devoted to fungous diseases. Dr. Nisbet points out that though serious disease and even death may result from the attacks of fungi neither fungous nor any other diseases of trees can be transmitted through seed collected from infected trees. The external structure and development of fungi are treated of again under the misleading head "Life History." In a note on the prevention and extermination of fungi Dr. Nisbet quotes the late R. Hartig: "The best preventive measure against the outbreak or spread of fungous epidemics is the formation of mixed woods." Whilst the part of the work devoted to a consideration of the various fungi to be found in British

woodlands is of very considerable interest we must leave our readers to peruse it for themselves. The author classifies them into fungous diseases of the (1) foliage, (2) stem and branch, (3) root and base of trunk, and then gives, following the procedure adopted in considering injurious insects, descriptions, etc., of the various orders and species.

Chapter VI deals with the protection of the forest against injurious influences in the soil and atmosphere. The subject is considered under the divisions I—Protection against non-parasitic diseases of trees such as unsuitability of the soil or situation, giving rise to stunted growth and stag headedness and root rot; diseases due to external injuries such as wound-rot, premature seeding, bark bound trees. *II—Protection against wetness and* aridity of soil in which the question of drainage is considered; also the danger from sand drifts and dunes. III—Protection against injurious atmospheric influences. Damage may be caused in nurseries, young plantations and older woods by wind, frosts, heat, drought, aqueous precipitations (rain, snow, hail, ice, hoar frost), lightning and atmospheric impurities. The effect of storm winds is carefully dealt with, and methods of protecting as far as is within human capabilities, a forest crop such as judicious thinning, wind breaks, etc., are instanced. The damage which frost is capable of is too well known to need touching upon here. Protection from heat and drought, hail, rain, etc., as well as the action of atmospheric impurities, such as smoke from factories and smelting works, etc., are all dealt with in a concise manner. In concluding this review of this part of Dr. Nisbet's great work, we would offer our congratulations upon the evidence of the great store of minute and carefully acquired learning which it shows its writer to possess. We think the book holds a moral for us in India, for does it not cause us to pause and ask when we shall be in a position to produce such a work for this country?

E. P. STEBBING.

[The review of the first volume of Dr. Nisbet's work was from the pen of Mr. A. G. (Hobart-Hampden), Director, Imperial Forest School, Dehra. The review of the remainder of the work will appear in an early issue. Hon. Ed.]

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE INDIAN FIELD SHIKAR BOOK.

The Indian Field Shikar Book, by W. S. Burke, Editor of *The Indian Field*, Calcutta. 3rd Edition, Calcutta, Thacker Spink & Co. 1906 Price Rs. 5.

In a previous volume of the *Indian Forester** we recorded the appearance and briefly reviewed Mr. W. S. Burke's exceedingly handy little Shikar book. That it was a long felt want was soon apparent from the fact that a second edition was called for very shortly after the first appeared. Unfortunately, owing to some claims of infringement of copyright on the part of Messrs. Rowland Ward, the authors of "Horn Measurements," the second edition had to be withdrawn. Our previous review will have shown our readers the great value to the Indian Sportsman of the little work, and it is not too much to say that the enforced withdrawal of the book came as a grievous disappointment to numerous sportsmen who first heard of its existence in its disappearance and were thus unable to procure a copy. Nothing daunted, however, by fate's unkind stroke Mr. Burke set to work to redraft the Shikar book, with the result that we now have before us a third edition, and we may premise by saying that from the Indian Shikaris' point of view it is no whit inferior to the editions which preceded it. Before proceeding to a brief review of the book in its present form we may draw attention to one undoubted improvement. The game registers, instead of being bound up at the end of the book itself, are now inserted in a pocket in the cover and refills can be obtained from *The Indian Field* Office—a decided boon to those who like to keep records of the game they kill.

The author commences with a chapter on the big game of the country, giving the scientific and vernacular names of each speceis mentioned, its habitat, period of gestation (often still uncertain or

* Volume XXX p. 2 9.

quite unknown), description (a sportman's description unencumbered with technicalities), measurements, habits, the best place to aim at to ensure death and, lastly, record measurements. To the notes upon the latter is usually appended a table giving full details including locality where the specimen was shot and the name of the sportsman or the present owner of the trophy. In this edition the author has made a notable and valuable departure with reference to the measurements of the trophies he enumerates. In his own words "But what I regard as of more value to the present day Sportsman are the numerous measurements of big game shot now-a-days, and which must assuredly be of more interest to the Indian Shikari than records of trophies shot several decades ago"

The habitat given for the Serow (*Nemorrhædus bubalinus*) as "throughout the Himalayas 6,000—12,000 feet" will admit of modification. This animal is found at much lower elevations than 6,000 feet and has been shot in the Siwaliks.

Turning to the Game Destroyers the author points out that owing to the marked decrease in game in many parts of India owing to the increasing efficiency of firearms, the increase in native professionals and the extension of cultivation, it has become urgently necessary for all sportsmen to turn their attention to the game destroyers. Such animals as the leopard and smaller cats (indeed all the *Felidae*) wolves and wild dogs, civets and mongooses, martins and weasels, are all active game destroyers. Crows and owls are egg thieves and chick destroyers, whilst eagles, buzzards and falcons prey upon birds and pigeons. These latter birds of prey, however, also feed upon rats, snakes and other small noxious animals and so do good in this way. The Land Game Birds are next taken in hand and treated in the same way as the big game save that there are no tables of measurements. These are followed by the Water Game Birds and we feel confident that this portion of the work will prove of the very greatest use to 'wild fowlers'; for amongst no other class of sportsmen have we met with such gross ignorance coupled with such confidently-held and expressed opinions as to the names of the various birds

forming the contents of a bag of waterfowl, using the term in its widest sense.

The Sporting fish are divided into three divisions—the river, estuarial and tank fish. Under seasons for fishing no mention is made of the United Provinces. On the waters of the Dun Fishing Association and the rivers to the east the best seasons are April, May and September and October. The notes on care of fishing tackle should be of use to the tyro.

Mr. Burke next turns to the great subject of camp equipment, and although, in writing in a journal published under the auspices of the Forest Service, it is scarcely necessary to lay down views on a matter in which each of our readers would consider himself, from long practice, an expert, yet we have found a perusal of the author's chapter on this subject both instructive and useful. *Autres pays autres mœurs* and many a man serving in the distant south of this great Continent may, through Mr. Burke, obtain a wrinkle or two of how things are done in the far north. Space will not permit of our more than alluding here to the excellent Chapter on Guns, Rifles, and Ammunition. We note that the author apparently considers a ·450 No. 2 cordite to be powerful enough for any thing. The ·400 taking the Jeffery 3 inch ·450—·400 cartridge, loaded with 55 grs. of cordite and ·400 grs. bullet on the Jeffery No. 1 is not, in our experience, sufficiently powerful for bison.

The list of dâk bungalows must have been a difficult one to compile. We would point out that there is no longer a dâk bungalow at Mohand (Saharanpur-Dehra road) in the Meerut Division. It was closed several years ago. There is a Forest and Public Works bungalow, each with a chowkidar, at this place. We think Mr. Burke's Shikar wrinkles, which follow, will prove of use as well as interest even to the great body of district touring men who peruse this journal. His Sportsman's Library is excellent, although some of the books included are by no means easy to procure at the present day.

A note upon snake bites and their treatment, which is not quite so up-to-date as it might be, terminates Mr. Burke's work.

The book ends with reprints of the various Shooting Rules in force in the different Provinces of the country.

We are of opinion, an opinion which we pronounce without hesitation, that all sportsmen will join us in extending our heartiest thanks to Mr. W. S. Burke for the trouble he has taken to give us just what we all require when out in the jungles on shikar bent away from our reference books.—"A Sportman's pocket Vade Mecum"

EXTRACTS FROM OFFICIAL PAPERS

CONDITIONS AND EXTENT OF CEYLON RUBBER PLANTING.

(FROM THE "INDIA RUBBER WORLD")

Two facts of importance in connection with the planting of rubber now in progress in Ceylon and similar conditions are obtaining in the Malay States are (1) the wide distribution of the work, involving the interest of very many people, and (2) the systematic manner in which the new culture has been undertaken. It is to be noted, by the way, that all planting of the more important products in those countries is conducted on a comparatively large scale—generally by companies (often owned in England), whose estates are placed in the hands of salaried managers of experience and proved capacity.

The account keeping of these estates is required to be as carefully done as in mercantile houses or the offices of a railway manager; with directors and shareholders to be satisfied in the matter of returns, the estate manager must study every possible economy, while the best possible product must be obtained in order that good prices may be realised. Under such conditions is produced, for example, the Ceylon tea of commerce. Of course there are many privately owned plantations, but their methods do not vary, practically, from those on estates owned by companies. Not the least important consideration is the exchange

of views and results, through the medium of the well sustained planters' associations by which means whatever progress is made on one plantation results in the common good. It is under such *business conditions—it is by the experienced tea planters, as a* rule—that the planting of rubber has been begun. The planters who are now reporting a profit from rubber are applying to it the business-like methods of accounting by which they have determined the rate of dividends to be paid on the capital invested in tea planting. There is nothing haphazard, therefore, in the beginnings of rubber in Ceylon, though there doubtless may be mistakes while the planters are gaining experience, just as mistakes occurred in the earlier days of tea culture.

With regard to the distribution of the rubber planting, a reference to the authentic "Ceylon Hand Book" shows that the new culture has been undertaken on hundreds of established plantations, many of which are now beginning to market rubber. The extent of rubber planting promises to increase largely in the near future, in many cases with a view to the ultimate giving up of tea. And there is a growing tendency to concentrate several of the existing plantations under one management, through the formation of new companies of larger capital than in the past.

It may be of interest to some of our readers to see a census of rubber planting in one of the 38 Ceylon districts in which rubber has been planted. The district selected is Kalatura, in which exists nearly one-fourth of the rubber planting in the colony. In compiling these figures from the "Hand Book" for 1905-06, only those plantations are noted on *which rubber has been planted*; the figures relate to the total acreage under cultivation, the acreage in tea, and that in rubber alone, while in the form of foot-notes is indicated the additional planting of rubber on the same estates.

ESTATES WITH PLANTED RUBBER IN KALUTARA DISTRICT, CEYLON

Estates	Proprietor.	Resident Managers	Acreage. Cultd.	Tea	Rubber	Post Station
Ambetenne	Cooper, Cooper & Johnson, Ltd.	C. Henry	522	452	*a* 70	Neboda
Arapolakanda	Eastern Produce & Estates Co., Ltd	H. V. Bagot	604	401	*b* 20	Tebuwana.
Bogahagodawatta	A. Sirimane	J. A. Sirimane	455	210	*c* 10	Bentota.
Clontarf	General Ceylon Tea Estates Co., Ltd.	K. A. Burne & Cond.	232	195	A 38	Neboda
Clyde	Clyde Tea Estates Co., Ltd	G. G. Massy	303	240	63	Kalutara.
Culloden	Rosehaugh Tea Co., Ltd.	R. W. Harrison; A. C. Corbetta	1233	89	*d* 444	Neboda.
Eagle's Land	General Ceylon Tea Estates Co., Ltd	J. P. Dove	160	160	*e*	
Elladuwa	Dumbara Valley Tea Co. Ltd.	A. Bawa	8[illegible]	158	B 127	Kalutara.
Edekanda	Rosehaugh Tea Co., Ltd	R. Garnier & Conductor	378	426	*f* 83	Horana.
Frocester	J. E. H. Graham Clarke	J. E. H. Graham Clark	46		46	Neboda
Gikiyanakanda	Lord Elphinstone	A. G. Greme	13[illegible]	557	C 755	Neboda
Glanrhos	General Ceylon Tea Estates, Ltd	J. P. Dove & Cond'r	272	209	*g* 13	Neboda.
Glendon	Heirs of R. Booth	R. J. Booth	300	250	50	Neboda
Halwatura	Anglo-American Direct Tea Trading Co.	F. J. Wright; J. I. Hall	1171	1032	*h* 100	Ingiriya
Hatherleigh	Rosehaugh Tea Co.	R. W. Harrison; C. O. Macadam.	404	340	D 64	Neboda.
Kaluganga	Clyde Tea Estates Co., Ltd	[illegible]; A. Wood	96	17	21	Kalutara
Liliskillan	Clyde Tea Estates Co., Ltd.	G. G. Massey; A. Wood	176	243	33	Kalutara
Mahagoda	T. O. Van Rooyen	A. J. Van Rooyen	54	39	6[illegible]	Bentota
Malaboda	Lanka Rubber Co., Ltd	C. Henry	6[illegible]		165	Neboda
Middeleniya	Government of Ceylon	Conductor	20		20	Kalutara
Millewa	H. J. Pieris, J. P.	E. Fernando & Cond'r	1105	1000	10	Padukka
Miriswatta	H. Don Carolis and L. F. Fernando	Conductor	125	35	90	Horana
Meegama	Rosehaugh Tea Co., Ltd	R. W. Harrison; A. C. Corbetta	227		227	Bentota.
Neboda Group	Neboda Tea Co. of Ceylon, Ltd	R. Morison; Alex. D. Callander, Actg.	720	495	225	Neboda
Neuchâtel	C. C. Mee	C. C. Mee; C. J. Acamthwaite	800	475	*i* 322	Anguruatota
Padukka	Rubber Plantations of Kalutara, Ltd.	C. L. Vizard	34	..	34	Padukka
Pelagodda (including St. Columb Kille)	Kalutara Co., Ltd.	L. C. S. Marshall; H. P. F. Lyford.	818	682	*j* 125	Bentota
Pantiya	J. H. Strachan	P. W. N. Farquharson	563½	446½	*k* 117	Neboda
Perth (including Maputugala)	Ceylon Tea and Cocoanut Estates Co., Ltd.	P. T. L. Wetheral. (R. H. Algie, Actg.)	1047	410	*l* 20	Horana.
Pogahakanda	L. C. S. Marshall	K. A. Burne	243	227	E 16	Neboda
Putupaula (including Cruden)	Putupaula Tea Estates Co., Ltd.	H. A. Tipple	576	400	*m* 176	Neboda.
Ravigam	Ravigam Co., Ltd.	A. J. Dawson; C. T. Sinclair	802	696	*n* 106	Padukka.
Rogart (including Ellangsland)	Heirs of R. Booth	R. J. Booth	436	249	183	Neboda
Sirikandura	Mrs. Jeremias Dias	G. M. A. Perera	375	370	*o* 5	Matu[illegible] Neboda
St. George's Group	H. V. Bagot, R. W. Harrison	C. Henry	386		386	Neboda.
Talagala and Knutsford	The Consolidated Estates Co., Ltd	C. L. Vizard	649	617	*p* 21	Padukka.
Tempo	F. G. McGuire and J. E. H. Graham Clarke	J. E. H. Graham Clarke	478	297	*q* 181	Neboda
Tudugalla Group	J. H. Starey	Herbert Inglis	702	550	*r* 202	Neboda
Vogan and Iddagodde	Vogan Tea Co., Ltd	W. N. Tisdall; R. V. Grimwood.	1085	816	*s* 69	Neboda
Yatadola	Kalutara Rubber Co.	C. Henry	374	100	274	Neboda.

NOTE.—The *italic* letters (*a*, *b*, *c*) in the Rubber column indicate the number of additional rubber trees planted among tea on the same estates, as follows: *a* 10,000; *b*—36,350; *c* 12,000; *d*—78,900; *e* 12,000; *f* 20,000; *g* 16,000; *h* 40,000; *i* 35,000; *j* 14,207; *k*—3,000; *l* 31,810; *m* 40,000; *n* 50,000; *o* 5,000; *p* 47,000; *q*—25,000; *r* 30,264; *s* 24,000; total, 499,331 trees among tea, without the acreage being specified.
The SMALL CAPITALS (A, B, C) in the same column indicate the number of acres of tea interplanted with rubber: A—15 acres; B 30 acres; C 25 acres; D 340 acres; E 10 acres; total 420 acres.

Photo. Mech. Dept., Thomason College, Roorkee

Photo by H. A. Latham

ACACIA CATECHU.

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INDIAN FORESTER

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THE INDIAN BUDGET AND THE FOREST DEPARTMENT.

During the discussion of the financial statement for 1906-07 at the Meeting of the Council of the Governor General of India on the 28th March, the following important references to the working and requirements of the Forest Department were made by Members of Council.

The Hon'ble Mr. Sim said: "The increased provision for expenditure on *Forests*, and the kindly mention of the *Tungabhadra Irrigation Project*, will be greatly appreciated. In regard to the former, I would again put in a special plea for all the liberality that is possible; parsimony in the case of Forests simply means postponement—postponement of all the benefits, which we expect and which we have led the public to expect, the forests will eventually yield in return for present inconvenience; liberality means hastening those benefits, and there can be few departments in which a policy of vigorous development and liberal expenditure will more rapidly repay itself. For the staff, too, I would bespeak the most favourable consideration of Government, when occasion offers,

for the work of a Forest Officer is work of a high order, and the conditions under which it is carried out are exceptionally arduous."

The Hon'ble Sir Denzil Ibbetson said: "As this is the sixth and will be the last time that I shall have the privilege of addressing the Council in connection with the Financial Statements, I should like to say a word upon a subject to which I have not hitherto had occasion to refer, but which is very closely connected with the agricultural interests of the country I mean the Forest Department of India, for which my Hon'ble friend Mr. Sim has pleaded so eloquently -and the occasion is the more appropriate, since it was exactly fifty years ago last January that Dietrich Brandis, the father of scientific forestry in India, entered the service of Government. I doubt whether the general public realise the enormous actual and potential value of our forest property, the degree in which it already contributes to our revenues, and the success with which it is managed by the admirable service which is in charge of it.

"Twenty years ago the surplus revenue contributed by our forests to the public purse was a little over half-a-crore. The revised estimates for the year which is just expiring put it at a crore and a-quarter. And this, in spite of the fact that all those measures for the ascertainment, development and protection of our forests, which really represent capital expenditure upon the property, and which are not yet by any means complete, have been and still are paid for from revenue. The selection of forests for reservation or protection, their demarcation, the settlement of private rights in them, their protection from fire, the improvement of communications upon which the profitable extraction of timber depends, and the provision of accommodation for the officers in charge—all these represent non-recurring expenditure which has been met from current revenue ever since we first seriously undertook the management and protection of Indian forests, and which still absorbs a considerable portion of the gross income, and when these processes are complete, we may look for a still more marked expansion of the net surplus.

"But the question of forestry in India has aspects far more momentous than the mere money value of the timber which is produced. Upon the maintenance of our mountain forests depends the steady flow of the rivers from which our great irrigation canals draw their supplies, while the protection of our hill forests is often (as lamentable experience has taught us) the only safeguard against the devastation of the cultivated plains below them. With the increase of population and the bringing of hitherto unoccupied areas under cultivation, the demand for fuel and small timber is daily increasing; while if the Indian cultivator is ever persuaded to restore to his fields in the shape of manure a fair portion of what he takes from them in the form of fodder, that demand must expand enormously. Our forests moreover annually afford grazing to great numbers of the cattle upon which agriculture is dependent, while in time of drought such as the present, they constitute invaluable reserves of grass. During the year which is just over, the Secretary of State has sanctioned proposals for the expansion and improved remuneration of the higher grades of the Forest Service, and we have under consideration similar proposals in connection with the executive grades and with the reorganisation of the Provincial Service, and of the school at which it is trained. We are also considering proposals for the establishment in connection with that school (which we propose to raise to the status of a college) of an Institute of Forest Research, which will place Forestry upon an equal footing, in respect of scientific enquiry and instruction, with Agriculture and Veterinary Science."

Readers of the *Indian Forester* will not need to be reminded here that the Hon'ble Mr. Sim is the greatest living authority on the requirements of the forests in the Madras Presidency, nor to be told how much of the success of Indian forest administration is due to Sir Denzil Ibbetson who has guided and controlled the Department for so many years. The pronouncements made in these speeches of the national importance of the Indian forests, of the necessity for their maintenance and improvement of the means under consideration for ameliorating the conditions of

service and of increasing the facilities for scientific research (to which we shall allude more fully in a subsequent number) must be of the greatest value in educating public opinion to a knowledge of the aims and objects of the Department, while the words of sympathetic praise for work accomplished will, no doubt, encourage its members to renewed efforts in the cause they have so much at heart.

His Excellency the Governor-General in Council conveyed appreciation in the highest form, when in the following words he suggested that the example set by the Forest Department might be followed with equally satisfactory results elsewhere. He said "Expert instruction in agriculture, will too, as years go on, undoubtedly conduce to the same success as has attended the scientific care which has done so much to realise for India the wealth of revenue contained in her magnificent forests." Indian Forest Officers may well be satisfied with this public recognition of their services to the State so generously and gracefully conferred.

SCIENTIFIC PAPERS.

ON SOME BAMBOOS IN MARTABAN SOUTH OF TOUNGOO BETWEEN THE SALWIN AND SITANG RIVERS.

BY SIR DIETRICH BRANDIS, K.C.I.E., F.R.S.

II

Two species of *Oxytenanthera* are common in this part of Martaban, to which must be added *O. parvifolia*, and a fourth species hitherto known as *Gigantochloa macrostachya*. The most common and best known of these is *O. albociliata*, *Wapya gale*, *Wagôk*, Burm.; *Wahklè*, Kar. (Mason No 6.) In 1880 this species was common in the Sinzwè reserve and it probably is still so. Not being tall and erect as the other bamboos associated with teak, but forming dense, low masses of culms bending over and nearly horizontal, it is not useful in drawing up the young teak trees and does not therefore tend to clear their stems and to make them tall and straight. This species flowers frequently, the spikelets are slender, curved, ½ – ¾ inch long and they are marked by the glumes being white ciliate along their edge. The branches

in the lower portion of the culms are stout and often single, the internodes are 15—24 inches long, 1—1½ inches diameter and the node rings are oblique

O. nigrociliata *Wapyu-gyi* Burm., *Wamay*, Karen, (Manson, No. 1, on the hills west of Papun). Densely tufted like the last,

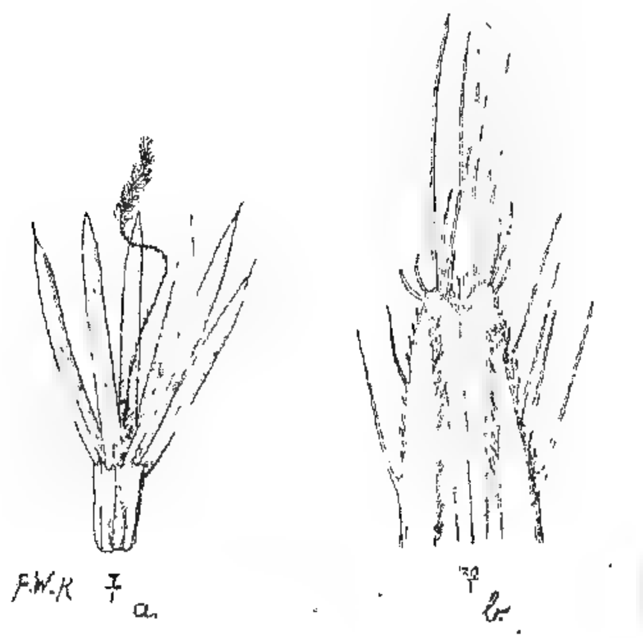


FIG. 4 OXYTENANTHERA NIGROCILIATA, MUNRO —*a* (× 7) Ovary enclosed in the short transparent staminal tube bearing 6 anthers with long mucronate tips. *b* (× 30) Bidentate tips of palea, with long stiff bristles.

but the stems are erect, the culms 30—50 feet high, nearly naked in the lower half, glossy green, finely streaked with white lines, while young. Culm-sheaths thickly coriaceous, densely clothed outside with dark brown or black irritating hairs which rub off readily, chiefly along the middle line. Two small round auricles at the top. Internodes 16—30 inches long, diam. 2—4 inches.

Glumes conspicuously dark brown, ciliate along their edge, palea bidentate with long bristles at the apex, anthers long mucronate, style at the end with numerous short papillose branches. (Figs. 4 5). This is a widely distributed species, from the Garo Hills and Sylhet over the whole of Tenasserim, to Singapore, also found in the Andamans and Nicobars.

Closely allied is a species, described by Kurz and figured by Gamble on tab. 54 of his excellent monograph of Indian bamboos as *Gigantochloa macrostachya* which I found in flower March, 1862, on the hills east of Shwegyin. The flowering specimens are, with many of my old Burma collections, at the herbarium of the Royal Botanic Gardens, Calcutta; but they were most kindly sent to me for examination by Lieut.-Col. Prain, while Superintendent of the Royal Gardens, Calcutta, and I have them now before me. The following description of this bamboo is extracted from a private letter of mine dated Taung dalay seik, 10 miles east of Shwegyin, March 2nd, 1862: "The low hills here are all covered with one kind of bamboo (*Wapyu gyi*, Burm.). This is a bamboo peculiar to the forests east of the Sitang river (in another MSS. note of mine I say 'taking the place of *Myinwa* of Pegu'). It is easily known by the white longitudinal stripes on the internodes. The country through which we have passed to-day, everywhere shows the marks of taungya cultivation, we passed over a number of taungyas, where the paddy had been cut in December last. Here, instead of the masses of tall herbs, such as *Blumea balsamifera* and tall grasses, the shoots of this bamboo are springing up from the rhizome, immediately after the paddy has been reaped, and hence the return to the original forest is much more rapid here than is generally the case in Burma." From my notes, written on the spot, I extract the following: "Clumps, lax or loose, not compact, nor large culms erect, 20-30 ft. high, internodes 18 in. long, 3 in. diam., node rings horizontal. Culm sheaths shorter than internodes blade triangular. Leaves glaucous beneath, mouth of sheath in the younger leaves with long bristles." On account of these bristles the late Dr. Th. Thomson called this species *Bambusa crinita*, the name was never published

by him and has now (Fl. Brit. Ind. VII., 387) been referred to *B. nutans*. Kurz (F. F. II. 557) in describing *G. macrostachya*, which he calls *wanet*, states that the blade of the culm-sheath is produced on both sides into large wavy fuscous fringed auricles; such culm-sheaths are figured by Gamble from Kurzs' specimens and from Kurzs' drawings in the Calcutta herbarium. I have no culm-sheaths of this species of my own collecting, nor are they described in my notes, but I accept Kurzs' description, supported by figures 4 and 5 of Gamble's tab. 54.

The structure of the flower is the same as in *Oxytenanthera nigrociliata*, but the fertile spikelets are much larger, 1—2 inches long. In both species the palea is bidentate at the apex and the style is simple. On tab. 60 of Gamble's excellent work the palea of *Oxytenanthera nigrociliata* is represented as entire, pointed at the apex, and the style as bifid at the top. Munro (Trans. Linn. Soc. XXVI., 129) says the style is trifid. I have examined numerous specimens collected by Helfer, Wallich, Manson and others in Martaban and Tenasserim, as well as Andaman specimens collected by Rogers and specimens from the Botanical Gardens, Calcutta, under the name of *O. auriculata*. In all cases I have found the tip of the palea bidentate, though in a young state the teeth sometimes had not separated. The style is neither bifid nor trifid, the lower and greater portion of its length is covered with short stiff hairs, while the upper portion is densely papillose and has numerous short papillose branches. (Figs. 4 a. 5 c.) This species of the hills east of Shwegyin undoubtedly belongs to the same genus as *O. albociliata* and *nigrociliata*. The anthers also, in all three species are alike, with a long, sharp prolongation of the connective at the apex, and the caryopsis is long cylindric. In Addenda to "Indian Trees" I have called it *Oxytenanthera macrostachya*, and I distinguish it from *O. nigrociliata* by the loose, not compact, clumps, the large wavy fringed auricles at the top of the sheath and the larger spikelets.

Eventually the arrangement of the two closely allied genera *Gigantochloa* and *Oxytenanthera* will have to be revised. Kurz

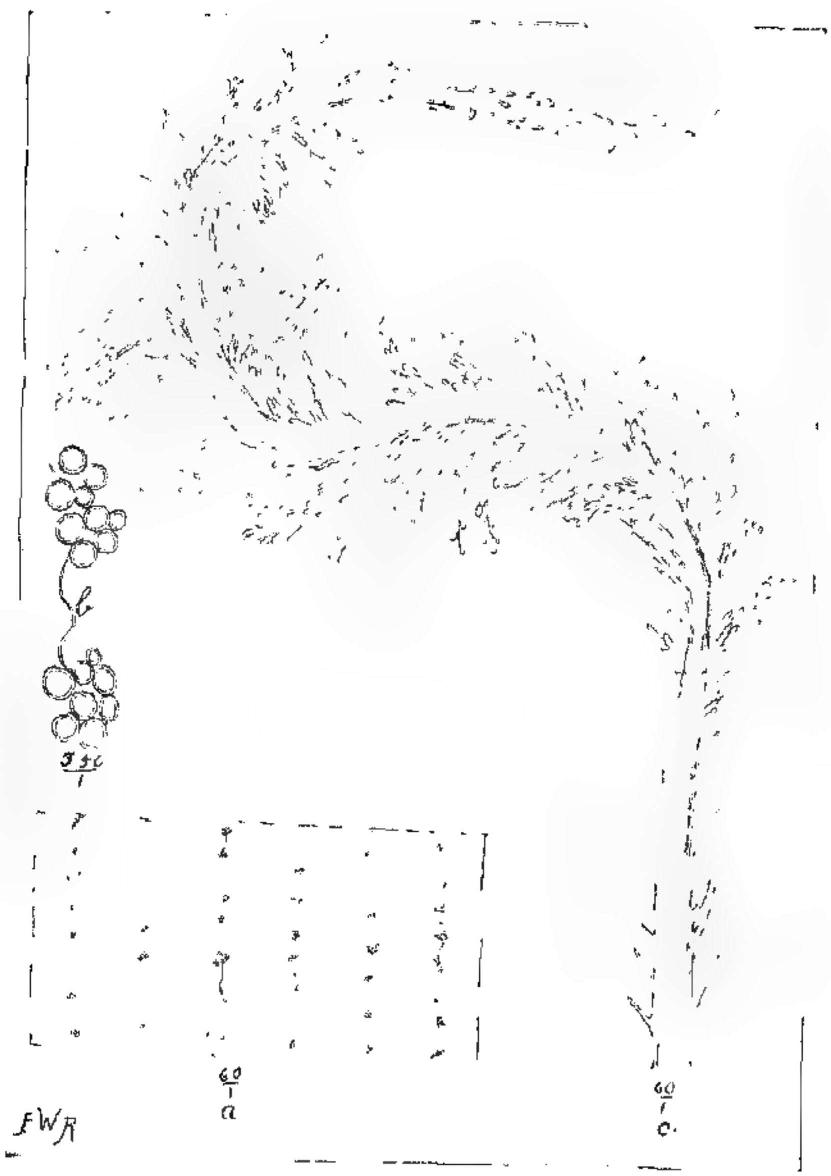


FIG. 5.—OXYTENANTHERA NIGROCILIATA, MUNRO.—*a* (× 60) Piece of transparent staminal tube, which now is 1 inch long, spread out flat, showing patches of torn annular and spiral vessels in 6 lines. *b* (× 350) two patches enlarged. *c* (× 60) Upper portion of style, below with sharp stiff hairs, above with numerous short papillose branches.

placed all Burmese *Oxytenantheras* under *Gigantochloa*, and as the latter is the older name, the names of these four species mentioned may have to be changed. Both genera have one important character in common *viz.*, that the filaments are connate into a transparent membranous tube, which in the young flower is as long as the ovary, with six fine fibro vascular bundles leading to the attachment of the anthers. (Fig. 4 a) As the anther matures, it lengthens out rapidly into a long, thin hyaline tube enclosing the style and elegantly marked by six lines of patches of torn, annular and spiral vessels, the remains of the fibro vascular bundles. (Fig. 5 a b.)

A fourth species of *Oxytenanthera, O. parvifolia*, I found, March 1880, in the Yunzalin district in flower with the Karen name *Wamo* It evidently flowers frequently, for the flower panicle collected by me has leaf-bearing branches. The spikelets are narrow-lanceolate ⅔ to ¾ inch long and the glumes are almost entirely naked along the edge. From Mr Manson I have received (No 3) with the same Karen name, leaves, a piece of the culm and several culm-sheaths. This bamboo was found by him on the road from Papun to Bilin and it was said to cover a square mile or so of country between the Mewaing stream and the Bilin river. A culm 63 ft long was measured, of which 52½ ft. were nearly naked, with only a few single branches, each branch accompanied by a few small twigs. The internodes 23 26 in. long, diam. 3 4 in The undeveloped buds are shining, flat, acute, 1 in. high and 1½ in broad The culm-sheaths are large, rigidly coriaceous, almost glabrous on both sides, very shining on the inside and with few golden-brown hairs on the outside. Manson adds that the base of the sheath remains attached to the node with a fringe 1½ in wide near the bud.

The specimens of *Wamo* collected by me in 1880 have this in common with Manson's *Wamo*, that the nodes of branchlets are thick, the two node rims distant, and the base of the culm sheaths persistent further that the leaves have on their inner edge long, sharp teeth, (thick walled hairs) while the outer edge is without teeth or has only a few small ones. Against their

being the same species is the size of the leaves 3—5 by ½—⅔ in. N. 40—45 on ¼ in. (1880) and 10—12 by 1—1¾ in. N. 24—30 on ¼ in., with a large conspicuous ligule in those collected by Manson in 1905. It is however possible that the leaves collected by me in 1880 were all from flowering culms and in bamboos these leaves are frequently stunted. Unfortunately I have no full description of the species which I called *O. parvifolia* in 1880. The Burmans who were with me at that time called it *Thaiktu-myinta*, indicating a resemblance to *Bambusa tulda* and *Dendrocalamus strictus*.

Before leaving *Oxytenanthera*, I wish to draw attention to the order in which the flowers open in the spikelet. At the base of each spikelet of *O. nigrociliata* are 3—4 empty and above them 3—4 fertile glumes. Of the fertile glumes or flowers I have always found the uppermost furthest advanced. In several cases I found in the lowest flower the staminal tube short, not longer than the ovary, while in the middle one the staminal tube was 1 in. long, enclosing the style, the uppermost flower containing a mature cylindric caryopsis, ¾ in. long. In other bamboos I have found the lowest flower furthest advanced, which probably is the usual order of development in bamboos. With dry specimens it is difficult to carry research on this point to a satisfactory conclusion, and I would recommend the study of this important question to my younger friends and colleagues in Burma.

The next to be mentioned are two evergreen bamboos which are often climbing, with large leaves and very long internodes. *Teinostachyum Helferi* (*Pseudostachyum Helferi*, Kurz) usually called *Wathabut* Burm., the Karen name of which I noted as *Thochi* in 1859 in the Salwin hills. This is Manson's No. 4, called by him *Thaw-khwè*, Karen and *Wanwè*, Burm., and collected by him on the hills east of Papun. The specimens, pieces of culm, culm-sheaths and leaves agree, and though Manson does not mention the climbing habit, it is indicated by the name *Wanwè*. The internodes are 2—4 ft. long, diam. 1½ in. grey with white appressed bristles, the culm sheaths 8—12 in. long, tapering gradually to a truncate apex 1½ in. broad with a dense fringe of

persistent bristles, ¼--¾ in. long, blade narrow, erect or recurved. Leaves 12—18 by 2 ¼ in., nerves 12-21 on ¼ in. (Fig. 6.) The flowers of this species are imperfectly known.

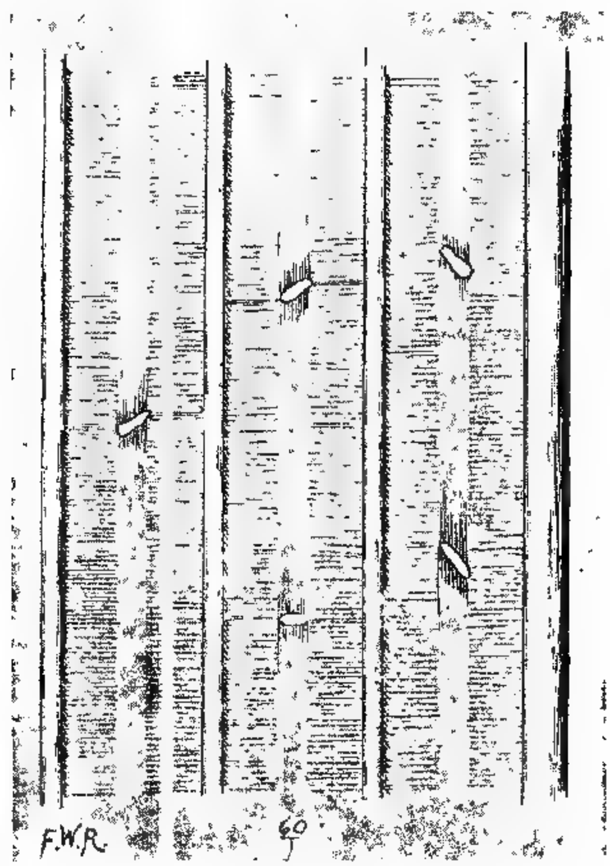


FIG. 6.—TEINOSTACHYUM HELFERI, GAMBLE.—Piece of leaf (× 60), showing three fine and one stout longitudinal nerve with bright bands of silica cells between (18 n on ¼ inch). Transverse veins, obscure, visible as bright spots (transverse pellucid glands, Gamble).

Dinochloa Mc Clellandi. Wanwè, Burm. (*Baw*. Karen, *Sinninwa*, Burm., Manson No. 5.) On the hills east of Papun, near the Metharauk stream. Slender, culms zigzag, nodes much swollen,

internodes 3—4 ft. long, diam. 1 in. At the nodes, both above and below the lower ring (scar of culm sheath) a band of fine-felted white unicellular hairs, ½ m. m. long. Leaves 12—24 by 2—5 in.

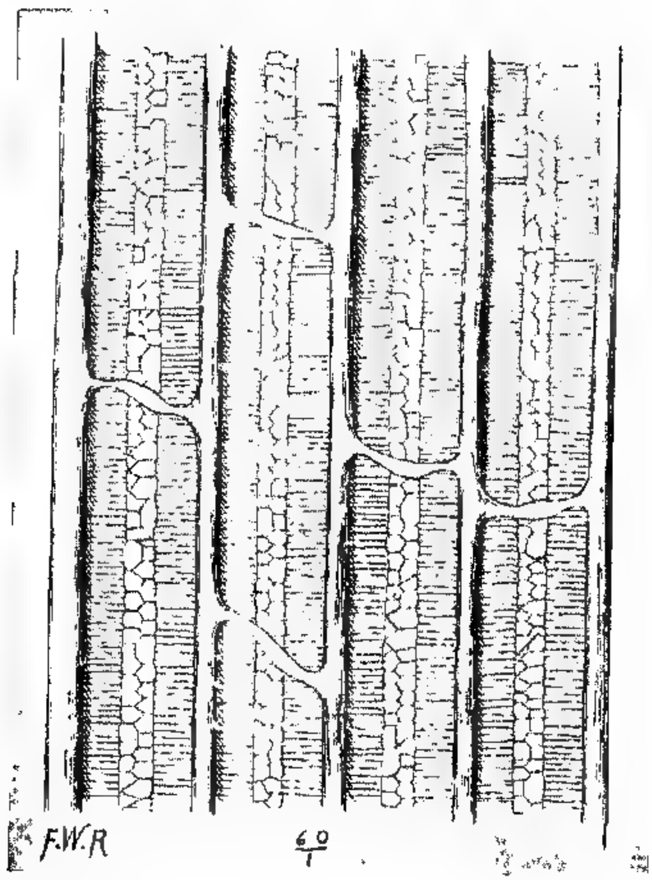


FIG. 7. PSEUDOSTACHYUM POLYMORPHUM, MUNRO.—Piece of leaf (× 60) showing four fine and one stout longitudinal nerve with bright bands of silica cells between. Transverse veins distant, oblique (21 n. on ¼ inch)

narrowed into a broad stout pet. ¼—½ in. long, n. 2—21 on ¼ in. Flowers unknown. Good specimens in flower and ripe seeds of these two species would be very valuable.

Another species with overhanging culms, often supported by neighbouring trees, is *Pseudostachyum polymorphum*, common in Sikkim, Bhutan, Assam, Manipur and Upper Burma, where it is called *Baua* or *Bankwa*. I mention it here as an instance of a bamboo, the leaves of which have prominent transverse veins, the longitudinal nerves being far apart (18—22 on ¼ in. Fig. 7). All bamboo leaves have transverse veins, which run across from one longitudinal nerve to the next, straight, oblique or with a bend in the middle. In many species these veins are not conspicuous, they can however frequently be seen as bright translucent dots at the point where they cross the transparent band of silica cells which in all bamboos is found halfway between two longitudinal nerves. In his excellent monograph of Indian bamboos, Gamble designates these as pellucid glands. On Figs. 6 and 9 an attempt has been made to represent these translucent dots. In *Melocanna* they are very obscure, they are more distinct in *Teinostachyum*. In all bamboo leaves the transverse veins can be made conspicuous by scraping off part of the tissue filled with chlorophyll or by bleaching re-agents.

ORIGINAL ARTICLES.

FIRE PROTECTION AND THE NATURAL REGENERATION OF DEODAR IN THE FORESTS OF THE KULU DIVISION, PUNJAB.

BY GURAN DITTA MAL, FOREST RANGER

Almost all the forests of Kulu are situated near the tops of the ridges, the lower parts of the valley being occupied by cultivation or bare grass lands. There is a fairly continuous belt of forest above the cultivation and grass lands. This feature is most conspicuous in the Kulu Range, which, properly speaking, consists of the Beas Valley.

Prior to the formation of the Forest Department, almost all the bare grass lands, as well as the forests, were annually burnt

to give a good crop of grass to the people. But in the early eighties, the demarcation work was commenced and almost all the wooded area was closed against firing. At that time it was thought proper to allow the people to continue burning the bare grass lands locally called "Phats" A detailed list was prepared, giving the name, approximate area and the boundaries of each "Phat." This practice continued, but in the year 1888 or 1889 for some reason or other, the people were no longer allowed to burn these areas, and the result was that all the forests together with these "Phats" were maliciously burnt by the people from one end of the valley to the other. This led to much litigation and resulted in about Rs. 11,000 being realised as fines from the people in one year.

In those days the system of joint responsibility of the right-holders existed in the Valley, and in the case of every fire, all the right-holders of a village were punished, if they could not produce the real offender. This caused "zulum" in several cases, as a man of one village bearing enmity to the men of some other village would wreak vengeance on them by firing their forests. This system of joint responsibility was therefore abolished in the year of 1891 or 1892.

At the time of the Forest Settlement in the year 1884, efforts were made to include every possible forest area within the demarcated forests, which were taken under strict protection, setting apart the undemarcated "Phats" to be burnt by the people under the control of the Forest Department.

Although this work was carried out with, perhaps, an excess of zeal, many undesirable areas with a few scattered trees only, having been included in the demarcated forests the result has been marvellous and beyond all expectations. In some cases slopes which were absolutely bare at the time of demarcation about 20 years ago are now densely covered with deodar and kail poles with full or rather too full a leaf canopy. All this has come about naturally. Wherever there was any seed bearer, on the bare slopes or in the forests, young seedlings came up like weeds and covered the area in no time. One who sees such places now can scarcely

imagine that these slopes were absolutely bare only 15 years ago.

Fortunately there has been no serious fire in these forests to kill back the natural regeneration. Luckily the Kulu people never think of propitiating their dieties by burning the forests, as some other hill tribes are in the habit of doing

The custom of "Phat" burning is still in vogue in the lower part of the valley. The fact that the people of the upper part of the valley can do without "Phat" burning clearly proves that the practice is only a luxury and not a necessity

"Phat" burning has both its advantages and disadvantages.

The advantages are :—

(1 The people being allowed to burn these "Phats" have no interest in burning the valuable wooded forests.

(2) The 'Phats act as fire lines, for having been burnt in the month of February, they stop any outside fire crossing into our forests in the fire season.

The disadvantages are :—

(1) The burning of the "Phats" does not allow these slopes to be covered with trees and hence no natural reproduction can be obtained This means that the forests cannot be extended in area, which is however very necessary in order to meet the increasing demand both for local supply and for export into the plains.

(2) A surface layer of soil cannot be formed, and in all these "Phats" bare rocks are cropping up to the surface.

But the total closing of these "Phats" might lead to disastrous results such as were witnessed previously in the year 1888 and 1889 We should now begin to restrict the "Phat" areas by closing small areas adjoining our forests and adding them to the demarcated forests.

In my opinion the people burn much more area than they actually want for their grass lands and the gradual closing of small areas would not entail any great hardship upon them.

CATECHU AND CATECHU BOILING.

BY H. A. LATHAM, I.F.S.

In South Canara one of our most profitable sources of revenue is the extract obtained by boiling the wood of the catechu tree.

The tree is botanically known as *Acacia Catechu* (Willd.) and locally by the Canarese name *Káchu-mara*, the first portion of the name being the vernacular variant of catechu.

The catechu is a "reserved" tree. It is armed and belongs to the natural order *Leguminosae*; it reaches a girth of about 4½ feet and a height of 20 to 25 feet (*vide* Plate XVIII). The tree is confined to the laterite plateaux in the Coondapur taluk, situated as a rule within 15 miles of the sea and gradually dies out as we proceed southwards until near Coondapur itself the tree will hardly grow. It appears again to a small extent in the Kasaragod taluk 80 miles further south, but no extraction is done there now. It yields a good firewood and the wood is heavy and durable but cannot be obtained of any large size.

The extract is astringent and besides the other uses it is put to it appears to be a remedy for diarrhœa, dysentery and diabetes; it is, however, chiefly used for chewing with *pan supari*; locally, it is used pure in small pieces, the size of a pea, and rolled up with the other ingredients in the betel leaf to form a chew. In Mysore, the catechu bought by the merchants from us is dissolved in water and the areca nut is, after being boiled and sliced, steeped in the solution and then put out in the sun on mats to dry, this operation being repeated until sufficient catechu has been taken up to form a red, shining, semi-transparent film through which the ruminated albumen of the areca nut is just visible; the brighter the red colour so obtained the better the quality of the nut.

As we see it the catechu is in the shape of hard round balls covered with a whitish dust, the ashes with which the balls are covered to prevent them adhering to one another; on breaking, the interior of the balls should show a vitreous conchoidal fracture similar to quartz and be of a warm reddish brown colour.

The manufacture of catechu which I will now attempt to describe is carried out under departmental supervision by a

PORTIO·I OF A CATECHU EXTRACTING CAMP,
H:sur, Coondapur Range. S Canara.

Photo.-Mechl. Dept., Thomason Coll:ge, Roorke. Photo by H. A. Latham,

INTERIOR OF A CATECHU STORE SHED.

contractor who is paid on the outturn and is bound, for the actual boiling, to employ only Kudubies, a local tribe of aboriginals.

So far as the department is concerned, a locality where there are plenty of catechu trees is selected and all trees over 6 inches in diameter are allowed to be cut; the contractor has to engage the Kudubies and select the site for the ovens, conveniently situated both for water and firewood, and also as close to the majority of catechu trees as he can get it. The site usually selected is a rice field for which the contractor may have to pay a small rent. Generally, however, no rent is charged as the owner is only too glad to have the ashes, obtained in extracting, to plough into his field. On this field the encampment is made, consisting of rows of thatched huts made of grass and bamboos; the huts are about 6 feet high by 5 feet by 10 feet and about 15 feet apart, the rows being about 60 yards apart.

The first thing to do is to erect the ovens, known as "*Wolle;*" these are made by a party of men a fortnight or so before the main body come, the ordinary soil of the field is used and the ovens built to a height of 18 inches and placed about 5 yards in front of the huts at irregular distances, 1 or 2 to each hut.

The oven is an oblong, about 2 feet wide by 3 feet long with two openings above about 1 foot in diameter on which the boilers, common ovoid earthenware pots (*madige*) are placed; these pots are about 18 inches high with a diameter of 15 inches in the body and a mouth 8 inches across. The opening for the fire is placed on the windward side and extends to the far side of the second opening in the top of the oven, the smoke, &c., escaping through the spaces between the boilers and the oven; the earth forms the hearth.

Plate XIX depicts a corner of a catechu extracting camp and an interior of a catechu store shed.

To proceed to the details of the working the guard and the watcher go out the first thing in the morning and mark trees for the Kudubies to cut noting the name of the man, the girth and the length of the workable stem and branches. The Kudubi then cuts

the tree and chips off the sap wood, a ring about 1 inch wide, with his axe and brings it into the camp where a Forester is stationed who measures the length and girth of the pieces and takes the weight of wood brought in (The largest tree cut in 1904-05 was 3 feet 8 inches in girth and yielded 26 maunds* 7 lbs. of heart wood). The Kudubi then carries it off to his shelter and proceeds to chip it. In the afternoon he may have to go and get firewood, but generally he can get enough firewood in a day to serve for several days' boiling. So much for the men's work.

Mrs. Kudubi puts the chips (*chakkai*) into the pot nearest the mouth of the oven and fills it up with water putting a large flat wooden spoon on the top partly to keep the chips down, and lighting her fire allows it to boil As soon as this occurs the pot is tipped into a wooden trough (*marige*) placed alongside the oven and the pot with the chips is refilled ; this process is repeated six times. The contents of the trough are put into the second pot which is used purely for evaporating. The contents of this pot are replenished from the trough with a cocoanut baler (*chippu*) until all the extract obtained from the chips has been evaporated to a nearly solid residue ; the contents are then poured into a broken half pot and allowed to dry naturally, being stirred at intervals to enable the drying to proceed evenly. The extract (*rasa*) is of a yellowish brown colour when stirred, the surface being of rich redbrown. This stirring is done with a one-sided spoon (*satuga*).

To make the balls the woman covers her hands with a little wood ash to prevent the extract adhering to them and takes up as much catechu as she can close her hands on and presses it into shape These balls are paid for at Re 1-2-0 per 100 and are counted before the Forester next morning, and delivered to the contractor. This ends the work done by the Kudubies. When the balls have been counted in they are rolled by special men engaged for the purpose on a board sprinkled with a little wood ash and this is repeated daily for 3 or 4 days to consolidate them. These rollers are paid from 5 to 8 rupees per mensem ; 3 men and 4 boys were employed in 1904 05 and could roll 4,000 balls in a day.

* One maund equals 28 lbs.

Their pay aggregated Rs. 40 per mensem and they were supplied with food as well probably costing another Rs. 20.

After this daily rolling the balls are spread out in the receiving shed to dry in a single layer for the first day or two and after that they may be in two layers

After the fourth or fifth days' rolling they are put in a pit and covered over with wood ashes on which a little water is poured and on being taken out the next day are gone over and all balls which are soft or broken are then rejected, the good ones being put on the upper story of the stone shed to get quite hard and dry.

As far as I have been able to work out the cost of manufacture, the details are as follows per candy of 5 cwt.:—

	Rs.	a.	p.
Extraction	31	8	0
Rolling	2	12	0
Shed and ovens	1	0	0
Shelter for Kulubies	1	0	0
Sundries	1	0	0
Total ...	37	4	0

This is the maximum cost to the contractor.

The total quantity of heartwood chipped in 1904-05 was 11,527 maunds and yielded 63 candies and 9 maunds or about 11 per cent of extract ([illegible] maunds = 1 candy).

The contractor is paid Rs 42 per candy (for 1904-05 and 1905-06) and this price has gradually come down.

Sales are by tender and realized in 1903-04 Rs 200 per candy and in 1904-05 Rs. 175 per candy The lowest rate received since operations commenced in 1889 is Rs 126 per candy in 1892, when also the amount paid for the manufacture (Rs. 60) was at its maximum. The rates, however, have varied considerably.

An extract, of which specimens have been sent to England for valuation, has been prepared from the wood of Xylia dolabriformis by treating it in the same way as catechu, but is very difficult to get solid

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

A SWARM OF LOCUSTS.

Swarms of locusts are pretty common to most of us, but as this one has what I take to be somewhat of a peculiar history, I venture to put as much as came to my notice on paper.

This swarm was noticed first in the east of the Kumaon Division at the end of October last, travelling westwards. It arrived in the Ballia valley (along which the cart road winds to Naini Tal)

on the 3rd of November. It remained in this valley until the end of January 1906, eating up the entire rabi crop of the villages and doing a certain amount of damage to the forest. The locusts seemed to travel up and down, being apparently stopped by the frosts, between the elevations of 1,400' and 5,000'. I saw them myself at the higher elevations, having withstood a night of pretty severe frost, rising under the morning sun's rays and flying at once down hill without leaving a dead one behind them.

At the end of January a branch of the family forced the hills and took a line over Bhimtal, Bhawali, down the Ninglat valley, thence, spreading out, swept round the Chaubattia Ranikhet hill and passed on to the wheat fields of the upper Ramganga valley—in all in a bee line, a flight of some 50 to 60 miles over hills and through some pretty severe frosts. Many were left behind as the main body advanced, but the damage they did was of little importance. The remainder soon started after the first lot, but scattered tremendously, visiting many small valleys on the southern slopes, crossing an 8,000' ridge and disappeared to the north east of Almora.

I have known a swarm go to the snows and return in fair numbers, but this swarm was finished off in the middle of February by a three days' snowstorm. Even after this storm I saw a few still alive but in a very weak condition and unable to fly any distance. I have seen none alive since the 12th of March.

The damage done to the crops was heavy when they stayed any length of time. Wheat, barley, and rape eaten down more than twice is *practically a failure and 60 days' rice is being put in* instead. The same eaten down once and even twice has recovered. Of course these crops were not higher than 9" when first attacked.

The flora of the Ballia valley was also severely treated, but as many of the trees had dropped, or were dropping, their leaves, and as the summers' growth was complete, the damage was not so much as might have been expected. Of the principal trees the Chir (Pinus longifolia) suffered most, the locusts eating at the base of the needles and dropping the longer parts on the ground. The oak (Q. incana) was hardly attacked at all, neither was the sal.

The following is an alphabetically arranged list of the trees attacked, some of course worse than others, and where deciduous trees are mentioned the leaves before falling are referred to.

Albizzia Lebbek, Bauhinia Vahlii, Berberis asiatica, Bœhmeria rugulosa, Bridelia retusa, Cassia Fistula, Celtis australis, Cocculus laurifolius (to a limited extent only), Debregeasia bicolor, Eugenia Jambolana, Ficus religiosa, Ficus Roxburghii, Grewia laevigata and tiliæfolia, Heptapleurum venulosum, Mallotus philippinensis, Murraya Konigii, The nettle, Olea glandulifera, Pinus longifolia, Rosa moschata, Rubus ellipticus, Zanthoxylum alatum.

Those practically rejected were :—

Bassia butyracea Bombax malabaricum, Casearia graveolens, Ficus Cunia, Musa, Quercus incana, Shorea robusta, Terminalia belerica and tomentosa.

NAINI TAL : W. H. LOVEGROVE.
24th March 1906.

EXTRACTS FROM OFFICIAL PAPERS

IMPROVEMENT IN THE PAY OF THE ADMINISTRATIVE POSTS OF THE IMPERIAL BRANCH OF THE FOREST SERVICE.

We publish below for information a Resolution of the Government of India on the subject of an improvement in the emoluments drawn by the Inspector-General of Forests and Conservators of Forest. We regret that the Secretary of State was unable to accept *in toto* hte recommendations of the Government of India in this matter. It will be noted that the improvement in the allowances drawn no longer includes exchange compensation allowance or acting promotion for privilege leave vacancies.

Resolution of the Government of India, R. and A. Department, Circular No 4F., dated Calcutta, the 28th March 1906.

The Government of India have for some time had under consideration the question of the grading and emoluments of the Imperial Branch of the Forest Service, and have arrived at the

conclusion that, in order to maintain its efficiency, it is necessary to take steps to improve the conditions of the service. With this object in view they have obtained the sanction of the Secretary of State to the following enhanced rates of pay of the administrative posts:—

(*a*) The pay of the Inspector-General of Forests will be Rs. 2,500 and that of the Chief Conservator, Burma, Rs. 2,150.

(*b*) The pay of the three grades in the class of Conservator will be :—

			Rs.
First grade	...	...	1,900
Second "	...	...	1,700
Third "	...	...	1,500

The distribution of the total number of Conservators' posts among the grades will be equal, an excess of one falling in the second grade and an excess of two in the second and third grades.

(*c*) Present and future holders of the appointments of Inspector-General of Forests, Chief Conservator and Conservator will not be entitled to receive exchange compensation allowance; and in the case of Conservators no acting promotion from grade to grade will be allowed for privilege leave vacancies

2. These rates of pay will have effect from the 11th February 1906

J. WILSON,
Secretary to the Government of India

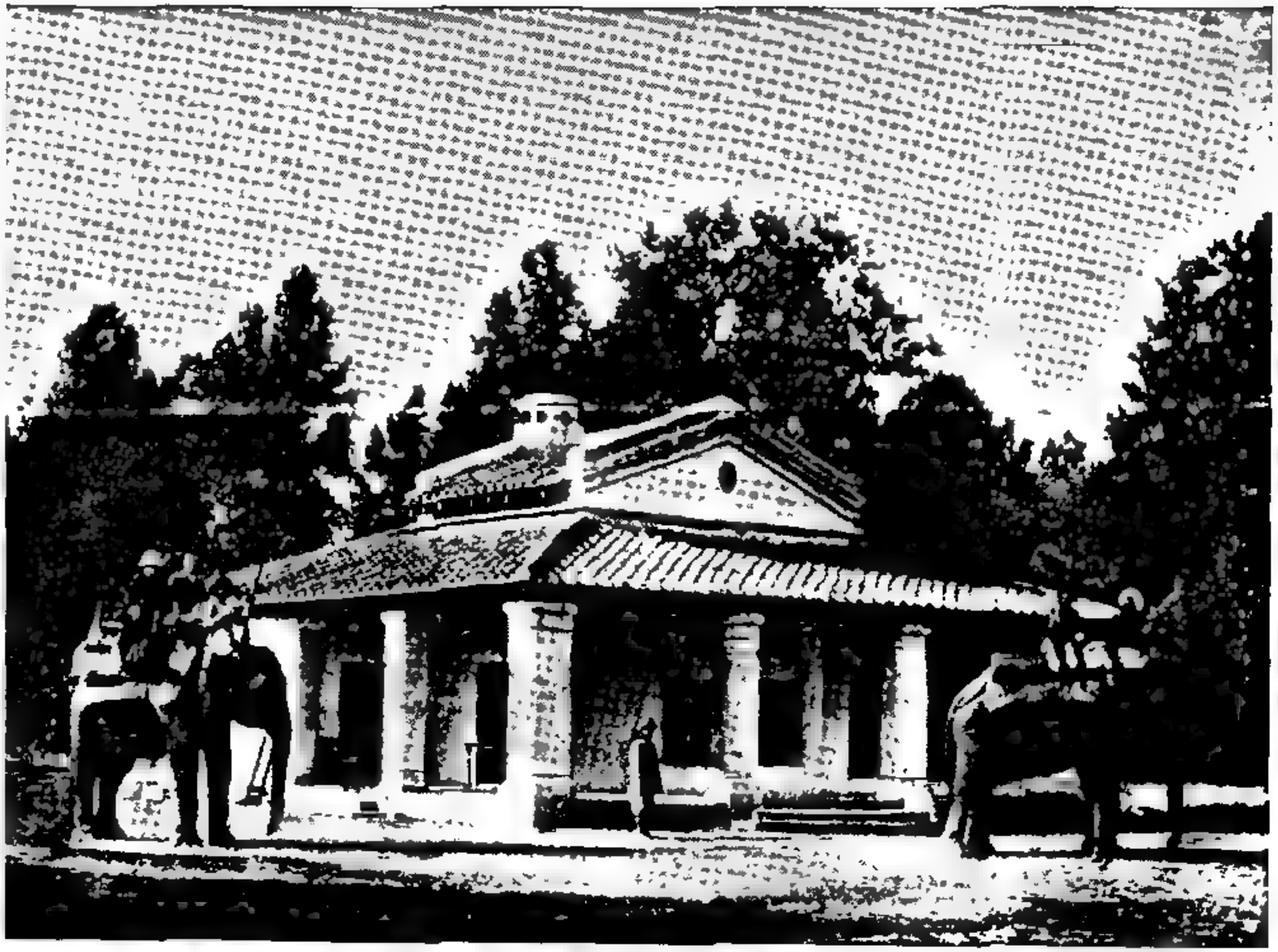


Photo.-Mechl. Dep't., Thomason College, Roorkee.

Photo. by F. A. Leete

FOREST HOUSE, ABDULLAGANG,
Bahraich Division, Oudh.

VOLUME XXXII NUMBER 6

INDIAN FORESTER

JUNE, 1906.

THE INDIAN FOREST RESEARCH INSTITUTE.

Date tempore prosunt.

We publish elsewhere a recent Resolution of the Government of India constituting an *Indian Forest Research Institute.* The idea of forming a central bureau or research station at which the numerous scientific and economic problems which constantly present themselves to the executive officers of the service could be investigated is no new one to our readers and has been under the consideration of the Government of India for some time past. It will be remembered that the formation of such an institute was suggested in these columns in January 1905. From the correspondence subsequently received on the subject, it became abundantly evident that the time was not only ripe for such a departure but that the members of the Department from the Inspector-General downwards had fully realised that without some such research institution it would be impossible to make that economic and material progress towards efficiency which they had so much

at heart. The unanimity on this point was as pleasing as it was satisfactory, and to the lasting credit of a rapidly developing branch of the Government service.

Our previous article will have made our readers acquainted with the general aims and objects of the research bureaux attached to the Forest Services of other States and with the general lines upon which the research work is carried out. In India whilst the aims and objects of the newly created research institute will be analogous to those of other similar institutions, the lines upon which the work will be carried out will require to embrace a much wider field and to be carried on on a much broader basis owing to the immense diversity in the character and conditions of the forest existing in the vast continent. We are ready to fully acknowledge the great value of the researches carried out, of the experiments attempted with success, and of the deductions recorded therefrom by the scientific forest research bureaux of other countries, but, whilst giving to an acquaintance with these the full measure of importance it deserves, for no officer of a research institute should be without a thorough knowledge of the work going on in his own particular branch throughout the world, we would strongly emphasise the fact that we must not rest on the deductions recorded from experiments made in countries outside India as applicable in their entirety to this country. In some instances they are so, or can be so modified as to be applicable, but in the vast majority of cases they are not. It is of little use glossing over the fact that this point has not been sufficiently recognised in the past either in or out of the Department. We have been content to rest upon the facts taught us when students about German and French forests, facts based upon researches in those countries, and with endeavouring to apply these to the Indian forests, even in cases where their application has not only been absolutely futile in practice but has rather tended to harm, and certainly to stagnation, than otherwise. Can we say that there has been any advance at all commensurate with the period during which the Department has had charge of the forests of the country, in our knowledge of the sylviculture of even the best

known and most valuable of our Indian trees? Most will agree as to the answer. Methods of sylviculture in Europe as a rule are not applicable to India, although we are far from saying that valuable hints may not be gleaned by their study. We read a remark the other day in an American periodical anent the total absence of Indian forest literature. What has been the reason? If we go no further than the columns of this Magazine volume after volume will show us that our very education has been the stumbling block and that, following other precedents in India, we have spent the years that are past in theorising and in futile efforts to apply the practices of Europe to the widely varying conditions of our vast forest areas in India.

In this ever recurring tread in the footsteps of instructors who either had never been in an Indian forest or who had received their education from the hands of such the Department cannot divest itself of all the stigma which attaches to the man content to blindly follow in the footsteps of his predecessor without attempting some advance for the better. The extenuating circumstances of heavy executive work and shorthandedness cannot be dealt with here nor is it now necessary since we are about to turn a new leaf. But whilst in such directions as the study of sylviculture and the methods of growing our tree crops best adaptable to the conditions of the country, we have not, owing to the blind following of the precepts of Europe, made that advance which could have been looked for after half a century of work; there are other directions in which it has been quite impossible for the Department, through its executive officers, to make any progress even of the smallest. The study of the injurious pests, both animal and vegetable, the chemistry of the widely varying soils and of the extremely numerous minor products of the forests and finally a knowledge of these minor products themselves have been quite beyond the power of the heavily worked executive officer to grapple with. No one but the specialist, the Forest Officer who having followed the ordinary educational course of his brother officers, has subsequently made a speciality of a particular branch of these forest sciences can hope to obtain, after perhaps years

of patient observation, investigation and experiments, such an acquaintance with his subject as to make his researches available from a practical and economic point of view to the Executive Officer. Owing to the recent enlightened action of the Government of India the Department will now have four officers each devoting himself to one of these special branches, and we foresee in the near future, and it may be written without hesitation or fear that the conviction will be found unjustifiable, that such an advance will be made in our knowledge of these subjects both in economic and scientific directions as will justify to the hilt the action of Government and the previous convictions of the Department as to the necessity of the present departure.

The position of the Department with reference to the work in connection with the preparation of Working-Plans has of course differed from its attitude to the other branches. It was impossible on the one hand to frame Working-Plans for areas of forests of which neither the boundaries nor the contents were known, nor on the other, was it necessary to do so for areas from which, owing to inaccessibility or for other reasons, no extraction of the produce could be undertaken. Nearly a quarter of a century ago Dr. Schlich, when Inspector-General of Forests, obtained the Government of India's sanction to the formation of the post of an Imperial Superintendent of Working Plans, the post being held by the Assistant Inspector-General of Forests. The creation of this post has until within quite recent years proved sufficient to cope with the Working-Plans work, the increase in the number of plans framed being necessarily slow at first. The work has now, however, increased to such a degree that the arrangement introduced in 1884 has become quite inadequate to cope with it. Also it has become essential that the Superintendent of Working Plans should be able to travel about the country and study the forests for which plans are being made. The Imperial Superintendent of Forest Working-Plans has now accordingly been made into a separate post and attached to the Research Institute. In the words of the Government Resolution the holder of the post "will collect and collate statistics of the

results of forest management throughout India, which are provided by the control forms annually submitted to the Government of India, so that the valuable information required in the different provinces will be made available to the whole Department. In addition to this he will assist the Inspector-General of Forests in the control at present exercised by the Government of India in the preparation of Working-Plans, performing in this matter the functions at present exercised by the Assistant Inspector General of Forests. In order to render this assistance more effective and to remove a serious defect in the present system, he will visit the forests in which the Working-Plans are being prepared, and will record a note upon the local conditions of the forest for the information of the Inspector-General of Forests. A copy of this note will also be sent through the Conservator to the Local Government for information, and for any action they may care to take upon it."

In this brief review of the aims and objects of the new departure we have endeavoured to put before the Department the work which lies before it and through it before the members of the Research Institute. We feel sure that we are but voicing the sentiments of the Service when we tender to the Government of India our sincere acknowledgements for one of the most important, economic and scientific departures which has been made since the creation of the Forest Department, and we have every confidence that the results achieved will fully justify the far-seeing statesmanship which has inaugurated the new policy.

Crabbe's lines would seem to be peculiarly appropriate to the present departure.

'Tis good, 'tis pleasant through th' advancing year,
To see unnumbered growing forms appear ;
What leafy life from earth's broad bosom rise .
What insect myriads seek the summer skies !
What scaly tribes in every streamlet move ;
What plumy people sing in every grove !
All with the year awaked to life, delight and love.

Then names are good for how without their aid,
Is knowledge, gained by man, to man conveyed?
But from that source shall all our pleasure flow?
Shall all our knowledge be those names to know?
No! let us rather seek, in grove or field,
What food for wonder, what for use they yield;
Some just remark from Nature's people bring,
And some new source of homage for her King.

And some new source of homage for her king

SCIENTIFIC PAPERS.

ON SOME BAMBOOS IN MARTABAN SOUTH OF TOUNGOO BETWEEN THE SALWIN AND SITANG RIVERS.

BY SIR DIETRICH BRANDIS, K.C.I.E., F.R.S.

III.

From pp. 151—155 of my report of 1881 it appears that *Tinwa, Cephalostachyum pergracile* is associated with teak in the Sinswè forests and in the Upper Salwin forests, on moist and not rocky ground.

The most remarkable species in this part of Martaban is a large single-stemmed bamboo (*Wabgai*, Kar., *Tabindaing*, Burm. Mason No. 2) which is fully described on p. 151 of my Burma report of 1881. I found it (leaves only) covering extensive areas on the hills at the head waters of the Metharauk stream, ascending in places to near the crest of the Buthiko range, as well as in the Sinswè forest of the Yunzalin valley. Mason found it in flower on the hills above Papun commonly growing in sheltered side valleys, and he also reports it from the head waters of the Bilin chaung, as far down as Hlagunbyo village. The culms are 40—60 ft. long, the lower half naked, without branches, with white or pale yellow stripes. The internodes are 22—29 in. long, 2½—3 in. diam., walls ⅓—½ in. thick. The sheaths are firm with black hairs outside, 8—13 in. long, gradually narrowing to an apex 2—3 in. broad, blade often as long as sheath, with a broad undulating band at the base on both sides.

The flowers received are all male and not in good condition, the tender parts being mouldy and mostly eaten by insects. The

spikelets are polished, lanceolate, sharply pointed 1—1½ in. long, solitary or in lateral fascicles of 2—8 spikelets, supported by coriaceous, truncate sheaths 1—2 in long. Two basal glumes are empty, then follow 4—5 flowering glumes with 21—25 longitudinal

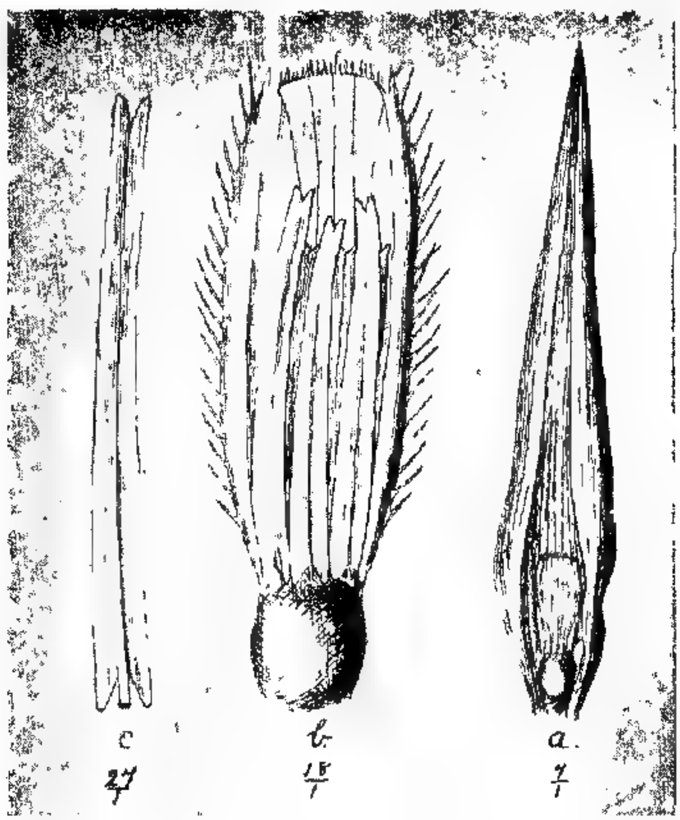


Fig. 8.—Waegai, Kar. *a* (× 7) Front view of flowering glume with the very short blunt transparent palea through which are faintly visible the anthers, seated on a fleshy torus. *b* (× 18) Palea with the anthers on a fleshy torus. *c* (× 27) Anther, bidentate at apex

nerves and few transverse veins. The glumes are naked, not ciliate along the edges, the flowering glume is $\frac{5}{8}$, the palea $\frac{1}{8}$ in. long. The palea is transparent, ciliate along the keels, with a

broad truncate top and ciliate apex. Anthers 6, bidentate at the tip, nearly sessile on a fleshy torus, no trace of lodicules. (Fig

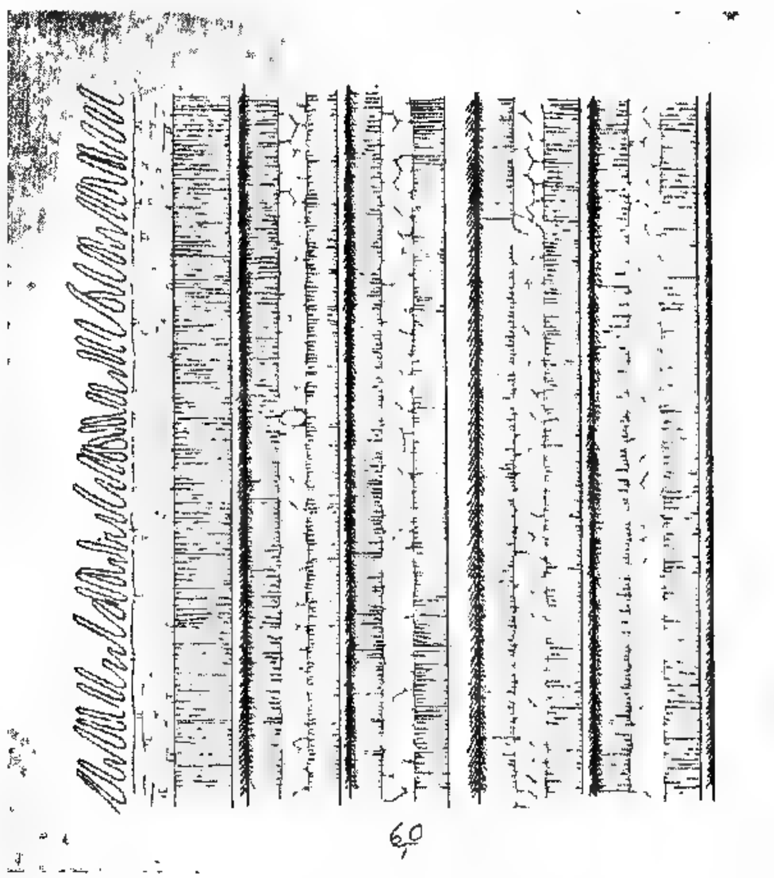


FIG 9 MELOCANNA BAMBUSOIDES, TRIN.—(× 60) Piece of leaf on the inner edge, showing on the edge a broad colourless band thickly set with fine hairs. One stout and 4 fine nerves with the bright bands of silica cells between. Very faintly visible 2 transverse veins where they cross the band of silica cells (24 n on ¼ inch)

8*a*, glume, palea and anthers. *b*. palea and anthers. *c*. anther.) The leaves are 8 9 by 1¼ in., underside glaucous, with

very minute hairs, teeth (hairs) on both edges small n 30 on $\frac{1}{4}$ in.

Until fruit and female flowers are obtained, the genus of this remarkable *Tabindain* must remain uncertain. Unisexual flowers are known in several genera, this character therefore gives no indication All species of *Gigantochloa* and *Oxytenanthera* known to me have pointed anthers. Of *Melocanna bambusoides* the culm sheaths leaves and flowers are quite different. For the present therefore it must continue to be known by the Karen name *Wabgai*. In "Indian Trees," p. 672, it is mentioned under *Gigantochloa*, to which genus Mr Gamble had referred it in his monograph.

Melocanna bambusoides (*Muli*, Beng.; *Kayin wa*, Burm.) the remarkable single stemmed bamboo, with large pear-shaped, fleshy fruit, seeds without endosperm, forms large forests in the Lushai and Chittagong hills, in Arakan and on the Upper Chindwin. It is not impossible that it may be found in Martaban, and hence I think it useful to draw attention to some remarkable characters in the leaf, to which C. B Smales first drew my attention. The end of the leaf is drawn out into a long point which below the tip has a bunch of long, fine hairs (Fig 10*a*). The inner edge is closely set with fine hairs on a broad colourless band (Fig 9), while the outer edge has a few short teeth (thick-walled hairs) (Fig. 10 *b*).

The figures here given of the leaves of some bamboos may serve to illustrate a character which in many cases will be found useful in order to identify bamboos of which leaves only are known. In some species the longitudinal nerves are close together, in others they are distant. Of the leaves here figured *Teinostachyum Helferi* has the nerves most distant, the specimen figured, 18 on ¼ in. *Pseudostachyum polymorphous* has 21 on ¼ in *Melocanna bambusoides* 24 and *Phyllostachys* sp. 33. It may be objected that broad leaves must necessarily have the longitudinal nerves more distant than narrow leaves, and this view is apparently supported by the fact that the leaf here represented of *Teinostachyum* was 2 in. and that of *Phyllostachys* only ¾ in. wide In broad

B

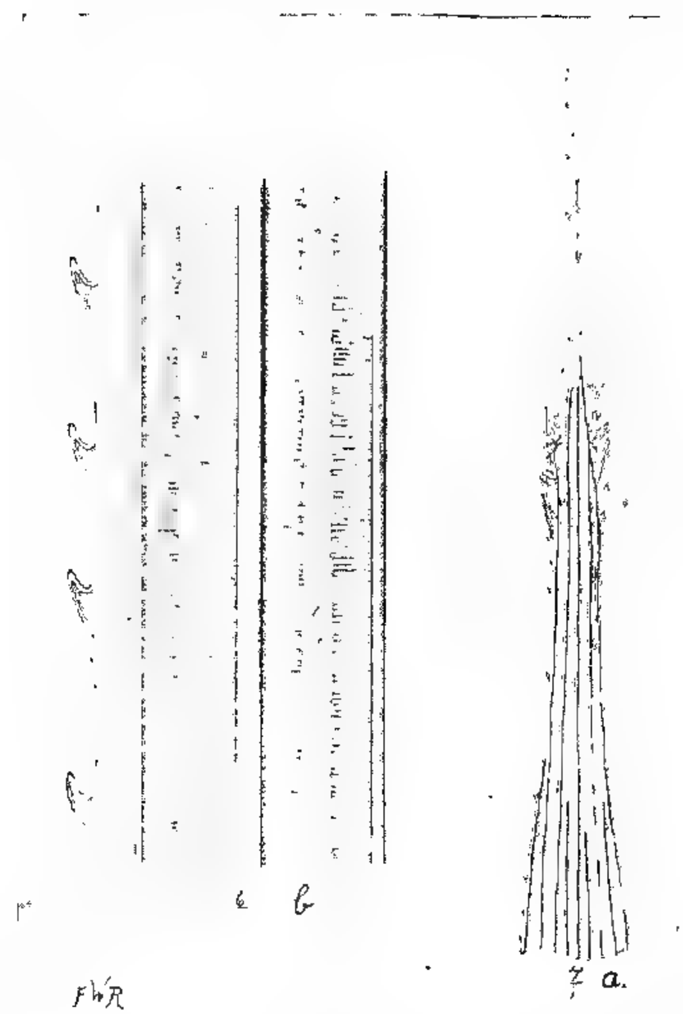


FIG. 10.—MELOCANNA BAMBUSOIDES, TRIN.—*a* (× 7) Tip of leaf, showing the long linear hairy apex with a brush of long fine hairs. At the base 8 longitudinal nerves, of which 3 only extend to the apex. *b* (× 60) Piece on the outer edge, a few teeth (broad thick walled hairs) on a colourless band. One stout and one fine nerve with two bright bands of silica cells.

leaves undoubtedly the longitudinal nerves are more often distant than in narrow leaves, but this by no means is the general rule. Leaves of *Arundinaria falcata* $\frac{1}{2}$ in wide have 36—45 nerves on $\frac{1}{4}$ in., while those of *A. Falconeri* of the same width have 21—27 and those of *A. Hookeriana* 21—24 nerves on $\frac{1}{4}$ in. Leaves of *Bambusa Tulda* 1 in. wide have 30—43 nerves on $\frac{1}{4}$ in., while leaves of *B. khasiana* of the same width have only 18—21.

Attention to the nerves and transverse veins in the leaves will in many cases facilitate the study of bamboos in India.

Returning from this digression to the single stemmed bamboos of Martaban I wish to mention a species, which as regards culm-sheaths and structure of leaf much resembles *Oxytenanthera macrostachya* of the hills east of Shwegyin. This species I found on the 25th February 1880 covering large areas on the hills south of the Thauk-ye-ghat river near the Tepu chaung, a feeder of the Yunkthawa stream. On the culm sheath, which is exactly like that figured on Gamble's tab. 54 is entered by me: *Tabin daing Wa*, Karen hills, February 1880. This species is therefore truly single-stemmed and not loosely tufted. On p. 141 of my report of 1881 this bamboo is mentioned with the remark that "the Taungya clearings had mostly grown up in bamboos and that the period allowed for the bamboo forest to grow up before it was cut again varies here from 7—15 years." Specimens collected by Kurz Burma, without locality (156) are exactly like those collected on the Karen hills in 1880.

To these two large single stemmed bamboos in this part of Martaban should be added a third, found by me in the Upper Salwin forests in March 1859 and described on p. 683 of "Indian Trees" with simple, stiff leafless branches on the lower nodes and small leaves. In 1859 the Karens called it *Wamu*. Mason gives *Wame* or *Wamey* as the Karen name of *Oxytenanthera nigrociliata*.

Finally I wish to draw attention in connection with these to the single stemmed bamboo of the Attaran forests a full description of which will be found on p. 683 of "Indian Trees." This like the single-stemmed bamboo of the Yunzalin, I found in 1858

associated with teak (Attaran report, p 165. Selections from the Records of the Government of India, XXXII, 1861). These four large single-stemmed bamboos of Tenasserim and Martaban must await further specimens, before they can receive systematic names.

One of the bamboos kindly collected for me by Mr Manson I am entirely unable to identify. It was collected on the east side of the Sinswè reserve and the Karen name is given as *Kanyaw*. It is described (Manson No. 7—) as a dark-green, more or less glaucous bamboo, internodes 24 30 in. long, and sometimes longer diam 2 2¼ in., walls thin, ¼ in, nodes not prominent, undeveloped buds flat, oblique, pointed, with a crustaceous, fragile margin and a pair of smaller buds at the base. The culm sheaths are firm, 9 in long, top convex with elegantly plicate and fringed auricles on both sides of the broad blade, which is nearly as long as the sheath. The leaves are 12 by 1- 1¾ in. glaucous beneath, at the top of sheath the remains of long bristles, nerves 33 on ¼ in. Regarding the mode of growth nothing is said. The leaves resemble *Oxytenanthera macrostachya*, but the internodes of this species are only 18 in long and the blade of culm-sheath is represented as short, triangular. The species of *Bambusa* which have large auricles on the culm-sheaths as far as known to me have a short triangular blade.

I do not apologise for having entered into such lengthy detail regarding the bamboos of Martaban. Teak in Burma is associated with bamboos and the correct treatment of teak to a great extent must be governed by a correct knowledge of the mode of growth and the requirements of the bamboos associated with it. The undergrowth of bamboos (*Kyathaung* and *Tin*, in fire-protected forests of the Kanin bilin working circle, to which (*Ind. For.* XXXI, 140, 505) Mr Troup, if I understand him correctly, ascribes the absence of teak seedlings in fire-protected areas, is a striking case in point. Troup states that they are not seedlings, hence the only explanation possible seems to be that the rhizome of these two densely tufted species, if protected against fire, throws out long underground branches, which produce this remarkable undergrowth.

It may be objected that of the 32 species mentioned here, only 13 are found associated with teak, *viz.*, *Bambusa Tulda, polymorpha; Thyrsostachy siamensis;* the four *Oxytenantheras; Dendrocalamus strictus, membranaceus, longispathus; Cephalostachyum pergracile; Wabgyi* and the Attaran *Tabin daing.* The study of the others, it may be said, is of no interest to foresters and may safely be left to Botanists. My reply to this objection is that the life-history of all bamboos must be studied in order correctly to understand the mode of growth and requirements of those species, which are habitually associated with teak. Hence I think I was justified in giving an account, as far as I was able, of all species known to me from Martaban. A knowledge of species is indispensable before the study of their life-history can be attempted.

The drawings, which illustrate this paper, are by Mr. F. W. Rolfe, youngest son of the distinguished Botanist, R. A. Rolfe, Assistant at the Royal Botanic Gardens, Kew.

KEW, *February* 1905.

ORIGINAL ARTICLES.

THE AMERICAN FOREST RESERVES.

BY CHARLES H. SHINN, FOREST SUPERVISOR, UNITED STATES

FOREST SERVICE.

Some time ago (in August, 1903) I wrote to the *Indian Forester* giving a glimpse of the life of a Head Ranger in the Sierra Nevada Mountains. To those who were able to read between the lines, I suspect that even this brief glimpse raised many doubts as to whether we Americans had yet learned how to handle our forestal resources. But since that time a great many things have happened, all interesting to fellow workers and full of promise for the future.

A year ago last January I was in Washington to attend a Forest Convention, and witnessed the transfer of the Forest Reserves of the United States from the control of the Department

of the Interior to that of the Department of Agriculture. This transfer has already proved to be one of the most successful pieces of constructive forest legislation ever passed by the American Congress. It put Mr. Gifford Pinchot, with his trained body of foresters and a well equipped central office, in entire control. The immediate result was that in the shortest possible time the whole thing was reorganized from bottom to top, the "weaklings" were weeded out, new blood came in, and actual forestry, for the first time, had its opportunity. In fact as well as in name, the Bureau of Forestry became the Forest Service of the United States.

The date when the actual transfer was made was February 1st, 1905, only fourteen months ago. Since then all of the old reserves have been reorganized (they numbered fifty-four in 1902, comprising about 60,000,000 acres); many new ones have been created; additions of considerable size have been made to old reserves; competent inspectors are examining large areas with a view to securing yet more reserves in the near future; comprehensive new legislation is now before Congress, and the work is everywhere taking strong hold upon public affairs.

The growth of the forest idea in America has been extremely slow, as might have been expected where such vast areas of seemingly inexhaustible coniferous and hardwood forests existed. Public interest was with difficulty stirred, and soon settled back. Many capable men tried to arouse the nation to the importance of forestry, but all that came of it was a mass of reports, memorials, resolutions and a few fragmentary laws. Between 1817 and 1858, Congress reserved certain tracts, in all 244,452 acres, in Alabama, Louisiana and Mississippi, in order to secure liveoak and cedar for naval construction. Then came the war between the States, and the age of ironclads, and hardwood reserves were abandoned. The Commissioner of Agriculture, however, continued to compile reports upon forestry. In 1877, for instance, Dr. Franklin B. Hough made a special report of 650 pages. In 1882 a Division of Forestry was established, and under successive administrations this report-making system necessarily continued. In 1882 also the American Forestry Congress was organized, and from this

developed the American Forest Association which has been one of the most important factors in shaping public opinion. In 1882 also, the American Journal of Forestry was established.

Thus matters moved on slowly, steadily, after the manner of republics, while a few workers, such as Hough and Fernow were hammering away at the thick shell of indifference. By 1898 the forest work of the United States was still mere report work and still a "Division"; it employed eleven persons, six of whom were clerks and subordinates and only two professional foresters. It was still an office without any field work worth mention.

This carries us over eighty-one years since Congress attempted to create Forest Reserves among the oaks of the south, and yet American forestry had not taken hold of the task. But by that time the leaders were in the service, or ready for it, and the next seven years witnessed a marvellous change. In July 1904 the "Division" of 1898 with its eleven men, had become a "Bureau" with 821 employés, 153 of whom were professional foresters. Field work of excellent quality was being carried on in twenty-seven States and Territories. Nearly a million acres of private woodlands and forests were being managed under the advice of the Bureau, and the demands for more of this kind of work were immense. A Forest School had been established at Yale; a science and a literature of American forestry had been created and had interested the public, so that graziers, lumbermen, railroad owners, clubs, conventions and all kinds of associations were being enlightened in a thousand ways in regard to the meaning of forestry. The whole field of action, by the leadership of a few capable men, was transferred from the desks to the forests. Better than all else, the Bureau of Forestry had fitted itself in these creative years to take administrative charge of the forest reserves, which had meanwhile grown up in the Land Office.

Secretary Wilson in his report for 1905, estimates the present value of the forest reserves at $250,000,000, and says that they are being administered at a cost of less than one-third of one per cent per annum. It is evident from a careful and conservative survey of the American field that the fifty-four reserves containing sixty-two

million acres of land which the Land Office formerly controlled will eventually develop into a perfected system including many Appalachian forests from Georgia to New Hampshire and hundreds of areas chiefly designed to protect the sources of water supply and to prevent grazing lands from being overstocked, in addition to pure forest reserves. If the management of the reserves continues to display the admirable qualities of energy, foresight and "plain horse sense" hitherto manifested, the time may come when the "American system" includes five or six hundred reserves covering three or four hundred million acres, while a Secretary of Forests and Waters sits in the President's Cabinet. The sixty-two million reserve acres of July 1904, grew by July 1905 to more than 85,000,000 acres, a gain of over thirty-seven per cent, and although future reserves will often be small, the field force is constantly discovering useful territory.

The bulk of the additions since February 1905 have been made in California, and the latest Reserve map shows to what a great extent forestry is certain to shape the social and industrial future of this immensely rich state whose area is about 99,800,000 acres, including lowlands, uplands, deserts, alpine peaks, rich valleys and varied climates from Norwegian to Italian. In Parks and Reserves California now contains about twenty million acres thus set apart for forestry, for game preserves, for tourists, and, in brief, for public uses. The "Use Book" tells the men of the service to administer their areas for the "greatest good to the greatest number," and that is a high ideal to follow.

Timber sales are under way in nearly all the California reserves, under trained inspectors and technical assistants, with students from the forest schools and forest rangers to do the surveying, scaling, marking, etc. Many of the seasoned rangers have been promoted "for excellent work" and some of them are now in charge of reserves of their own. The whole American forest force has been put under the Civil Service system and examinations are held at stated periods for rangers and supervisors.

The special need of California at present is for some kind of a Forest High School where forest guards and rangers of fair

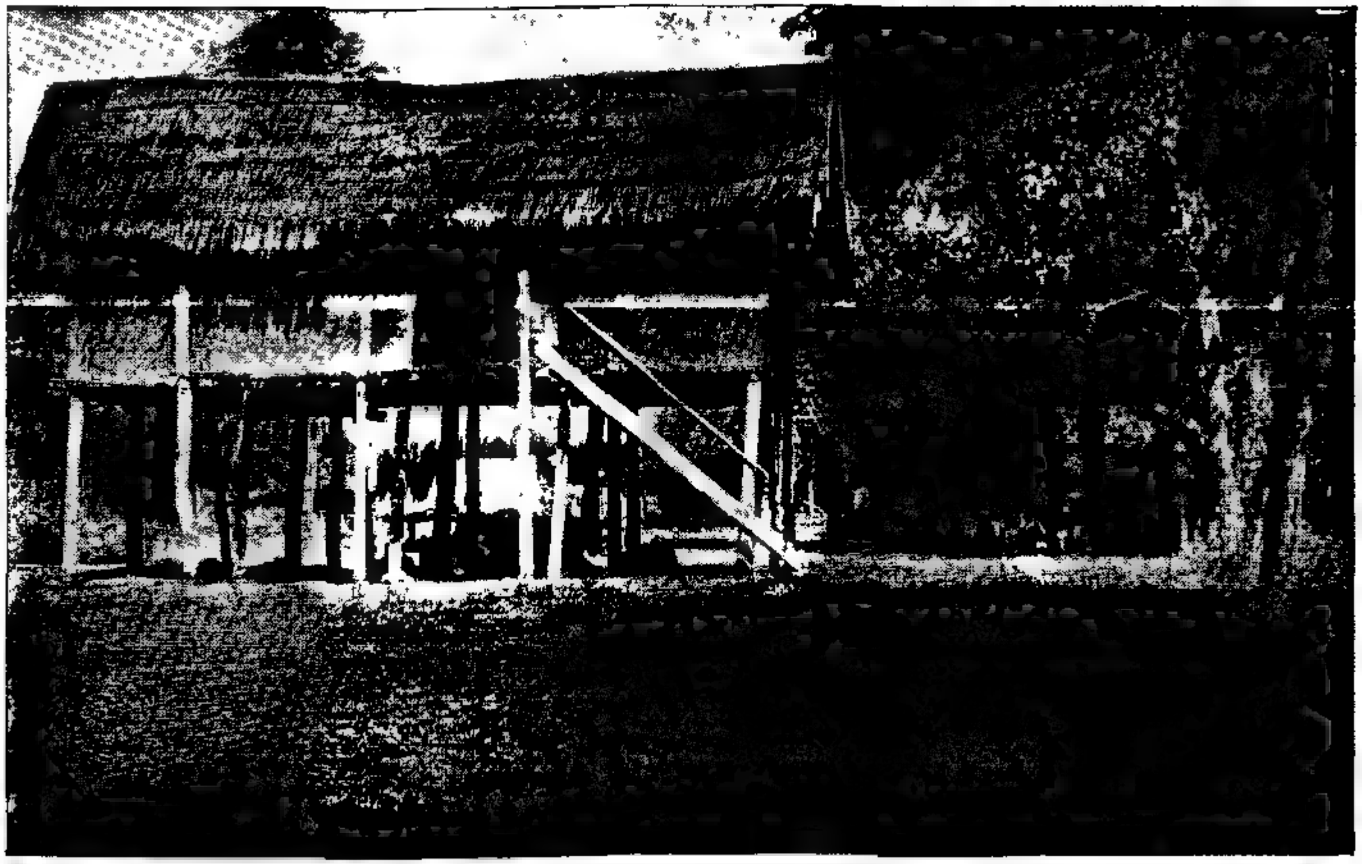


Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by F. A. Leete.

FOREST HOUSE, BAW,
Minbu Division, Upper Burma.

common school education can profitably spend successive winters, fitting themselves for promotion. Without this, some of our most capable mountaineers, quiet, unselfish, unconquerable men, are woefully handicapped for the growing requirements of the service whose demand for men far outruns the supply from the forest courses of our universities

In our work, distant though we are from India, we often gather inspiration and a multitude of administrative suggestions from your own great forest service. As we climb our Sierras we only get glimpses of pumas or wolverenes instead of your noble *felidæ*, we deal only with Basque sheep trespassers, with isolated half crazed hermits of the wilderness, with Mono and Chowchilla American Indians, with wandering trappers, hunters and prospectors—instead of with your picturesque and multitudinous primitive peoples. But still we feel that there is a true fellowship, somewhat more, somewhat deeper than that which generally unites foresters, for Californians have gathered much from the Indian Forest Service, and as years pass will doubtless gather more than ever before.

TYPES OF FOREST REST-HOUSES IN INDIA.

II. BURMA AND THE UNITED PROVINCES.

BY THE HONORARY EDITOR.

In the February issue of the *Indian Forester* we commented on the great disparity in comfort and healthiness of the rest-houses built by the Forest Department in different parts of India. In that number we showed pictorial representations of three rest-houses of the type to be found in the Naini Tal, Dehra Dun and Kheri Divisions of the United Provinces. We here reproduce, through the kindness of Mr. F. A. Leete, examples of two rest-houses of the Bahraich Division of these Provinces and two of the type to be found in the Minbu Division of Upper Burma. The startling difference between what is considered essential to ensure the comfort and health of the Controlling Staff whilst on tour in the one province when contrasted with that provided in the other speaks for itself.

When it is remembered that Burma gave a net surplus of Rs. 55,13,000 for the year 1904-05 and that its climate throughout the year is far inferior to that of the United Provinces, it is difficult to consider that the present state of affairs in the former Province is satisfactory, or that it reflects credit upon those responsible. That it has been due in great measure to the fact that the majority of the Burma officers joined the service in Burma and consequently have had no opportunity of seeing for themselves or ascertaining from others how things were done in the more go-a-head and up-to-date Provinces of India may be adduced as one reason for the present want to accommodation. Men took things as they found *them and apparently made no effort to have them different.* Within recent years, however, the transfer of a number of officers from India to Burma would seem to open out a hope that this condition of things will not be suffered to continue. In response to a request Mr. F. A. Leete, now in charge of the Minbu Forest Division in Upper Burma, has very kindly sent us the photographs we show in this number and has given the following notes about them:

Plates XX and XXII exhibit two rest-houses in the Bahraich Division. They are both built of pucca bricks set in mud mortar and lime-plastered inside and out. Plate XX has one large and two small rooms and two bath-rooms and cost Rs 2,000. Plate XXII two large and two small rooms, each of the latter with a bath-room. It cost Rs. 2,600.

With reference to the huts, both in Minbu, Mr. Leete writes as follows:

"Plates *XXI* and *XXIII* may speak for themselves; Rs. 50 for either would leave a contractor a fair margin of profit. Plate XXIII is not a 'forest' house, *i.e.*, not built by the Forest Department, but it is a very fair average of what Forest Department houses are like. Nine-tenths of the camping in Minbu is in huts of this description. Nevertheless when my predecessor drew up a preliminary report in 1904 for a working plan for the Magwe half of the division he remarked: 'Buildings are sufficient for the present as there are many Bombay-Burma Corporation huts (*sic*), besides the buildings belonging to the Forest Department.'

Photo Mechl. Lept., Thomason College, Roorkee. Photo. by F. A. Leete.

FOREST HOUSE, KAKADARI.
Bahraich Division, Oudh.

"The buildings referred to are nearly all of the style shown in the photographs (both Forest Department and Bombay Burma).

"In the whole division there is one house that cost Rs. 1,000, one of Rs. 800 and three of Rs. 400. All the rest are of the Rs. 50 type.

"Needless to state my predecessor had had no service in India. Fortunately there was time to change the preliminary working plan report and so it was done.

"The building of more houses of the Rs. 1,000 to Rs. 1,300 type was started, and it is hoped that the present rate of two to three new houses a year will continue for a long time to come."

We have ourselves, during a tour in Burma, occupied huts of the type shown by Mr. Leete both in the Katha, Tharrawaddy and Ataran Divisions. It is often advisable to wear a *topi* during the hotter portion of the day in these "rest-houses" so sparing has the contractor found it necessary to be, with the munificent funds at his disposal, with the materials of which the apology for a roof is composed.

It is perhaps needless to remark that with such accommodation in which to pass the greater part of the year the health of the Burma Forest Officers is far from good, nor can it be a matter for surprise if enthusiasm and energy are sapped and undermined by such unnecessary hardships and exposure.

REVIEWS AND TRANSLATIONS.

THE FORESTER.

By John Nisbet, D Œc

III.

PART V.—THE MANAGEMENT AND VALUATION OF WOODLANDS.

The management of a forest varies with the object it is desired to attain. Dr. Nisbet's work is primarily intended for the use of land owners and land agents who will ordinarily desire to obtain

the largest return on the capital invested, and the working of the forest with due regard to its continued maintenance will generally be arranged to this end. In the case of State forests, such as our Indian forests, however, the sole object with which these are administered is usually the public benefit, the legitimate demands for forest produce of the people, more specially those in the vicinity of the State forests, have to be fully provided for, the public as a whole benefiting by whatever surplus revenue may be obtained.

After dealing at length with the theoretical principles of woodland management, Dr. Nisbet treats of the measurement of timber crops, and then proceeds to explain the formation of working-plans, or the practical application of the theoretical principles which he has previously discussed.

As he justly remarks: "It is hardly possible for any large tract of woodland to be managed economically, and for the productivity of the soil to be fully utilised, unless the management is regulated according to a working-plan." It is to be hoped that the publication of Dr. Nisbet's work will lead to the more systematic management, by means of carefully prepared working plans, of many of the larger woodlands in Great Britain. A useful chapter on book keeping on woodland estates and a chapter dealing with the valuation of woodlands, with appendices, giving amongst other things, average yield tables for scots pine, spruce, beech and oak in Germany which should prove very useful, conclude Part V.

PART VI.—THE UTILISATION OF WOODLAND PRODUCE.

This part deals with the technical properties, practical uses and market value of timber, the harvesting and sale of woodland produce, the transport of timber by land and water, the preservation of timber, various industries such as the manufacture of wood pulp, charcoal burning, resin tapping, and saw mills are described and a note on grazing in woodlands and on leaf fodder is given.

For various reasons, the chief of which is perhaps the want of sufficiently skilled and intelligent labour, European methods for the harvesting of timber are in most cases, impracticable of adoption in India, and it is generally found necessary very largely

to utilise, whilst improving as far as possible, the native methods of felling timber, etc. So also in the matter of transport local methods have to be mostly adhered to, and in some cases, *e.g.*, the use of elephants for the extraction of timber from the forests in Burma, the methods in force could hardly, in any circumstances, be replaced by European appliances.

The preservation of timber by various processes is discussed at length ; so far, in India, the various experiments that have been made in this direction have not yielded very satisfactory results, but the information that is brought together in the chapter on this subject should prove of considerable use for reference. In discussing the outturn of the saw mills belonging to the Sierra Flume and Lumber Company (page 526) it is stated that the mills "have an annual output of 16 million metres of boards (575 millions of cubic feet) which represents exactly half of the annual outturn from the State of Oregon (1888)."

What is exactly meant by the expression "metres of boards" is not clear. The standard unit of lumber measurement in America is the 'board foot," a "board foot" being the contents of a board 1 foot square and 1 inch thick ; the term metre board perhaps means the contents of a board 1 metre square and 1 inch thick the cubic contents of which is something less than a cubic foot ; the outturn would therefore be between 14 and 15 million cubic feet instead of 575 millions. Moreover this latter figure, if correct, would mean an outturn of nearly 2 million cubic feet a working day, which seems incredible.

Dr. Nisbet is to be congratulated on having produced a work that cannot fail to be of the greatest use to all who are interested in forestry, more especially those who wish to introduce more systematic methods of management into the working of their forests and woodlands ; and it should serve further to stimulate the interest in forestry that has in recent years been evinced in Great Britain.

M. HILL.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

CAVE DEPOSITS IN KASHMIR.

During the year 1905 a cave, in a small valley locally known as Imselwara, was explored by the writer and Mr. Allen Campbell of the Kashmir State Railway Survey. This cave had been known to the writer for some years. Two explorations were made, but owing to the lack of proper instruments no real excavation was carried out. This year it is hoped that H. H. The Maharajah Sahib of Jammu and Kashmir will kindly provide funds to carry out systematic working, etc., under the management of the writer. As far as is known at present the

cave is formed by a ridge of calcareous sandstone blocking up the outlet of a small nalla. The formation appears to belong to the Zanskar system and consists of an intrusion of blue limestone, mingled with sandstone, in the Amygdaloidal Trap system of the Panjal Series. The cave is water worn and has been formed by the melting snow which collects in the basin above the cave. During the summer the latter is practically dry. The cave is situated about 800 feet above the level of the Woolar Lake.

There are two entrances to this cave. The main one is very large, but is blocked by a fall from the roof, until this has been cleared away nothing can be done here. The secondary cave is an offshoot from the main one, and although very much smaller is about five times the length. It was in this small cave that the bone deposits mentioned below were discovered. The cave consists of a long and tortuous passage with two chambers in it which have to be reached by actually crawling or rather worming oneself along. An outlet was discovered at the other end, but owing to the débris of wood, etc, which have been washed down a small crater-like depression, it was not possible to follow the cave further on. Various discoveries of bones have been made. At present these are confined to portions of the skeletons of:—

(1) Cervus aristotelis or the sambur ;
(2) Sus scropha or the European pig ;
(3) The teeth of an, at present, unknown antelope ;
(4) A tush of a bear, at present not identified.

These bones were found in the wall of the cave from 4 to 6 feet above the present cave bed level, and they are but a very small quota of what will be discovered when proper excavations are made which will be done systematically. The remains are probably about the same age as those found at Billa Surgam in Karnall. It is hoped that a full report will be made this year in the autumn as the Director of the Geological Survey, Mr. Holland, F.R.S., has very kindly offered to have any remains identified.

E. RADCLIFFE,
Kashmir State Forest Dept.

April 20th, 1906.

EXTRACTS FROM OFFICIAL PAPERS.

CREATION OF AN IMPERIAL FOREST RESEARCH INSTITUTE AND COLLEGE AT DEHRA DUN.

Circular No. 11 166-2-*F.*

GOVERNMENT OF INDIA

DEPARTMENT OF REVENUE AND AGRICULTURE.

FORESTS

Simla, the 5th June 1906.

RESOLUTION.

The Government of India have had under consideration the desirability of making better provision for scientific research in connection with Indian forests. They cordially acknowledge that the work of the Forest Department has been characterised by marked and progressive development, which has resulted in an improved condition of the standing timber and in a satisfactory increase in the net revenue derived by the State from its forests, while due regard has been paid to the interests and needs of the population residing in their neighbourhood and to the requirements of the future. The energies of the Department have, however, hitherto been largely confined to the practical management of the forests under its charge, and comparatively little attention has been directed to the work of research, which has been pursued with such beneficial results in other countries. In order therefore to provide a staff of experts who will be in a position to devote a large proportion of their time to the prosecution of scientific research connected with forest produce, as well as to give the best available training to candidates for the Forest Services both of British India and of the Native States, they have, with the sanction of the Secretary of State, decided to raise the status of the existing

Imperial Forest School at Dehra Dun and to add to its staff. The School will now be known as the Imperial Forest Research Institute and College, and the staff will include six officers of the Imperial Service, holding the following posts :—

(*i*) An Imperial Sylviculturist, who will make sylviculture his special study.

(*ii*) An Imperial Superintendent of Forest Working Plans who will collect and collate the statistics of the results of forest management throughout India, which are provided by the control forms annually submitted to the Government of India, so that the valuable information acquired in the different Provinces will be made available to the whole Department. In addition to this he will assist the Inspector-General of Forests in the control at present exercised by the Government of India in the preparation of Working-Plans, performing in this matter the functions at present exercised by the Assistant Inspector-General of Forests. In order to render this assistance more effective, and to remove a serious defect in the present system, he will visit forests in which Working-Plans are being prepared, and will record a note upon the local conditions of the forest for the information of the Inspector General of Forests. A copy of this note will also be sent through the Conservator to the Local Government for information, and for any action that they may care to take upon it.

(*iii*) An Imperial Forest Zoologist, whose chief duty will be to investigate the damage caused by insects and other pests, and to suggest remedial measures.

(*iv*) An Imperial Forest Botanist, who will study the botany of forest plants, the diseases of trees, and the distribution of species.

(*v*) An Imperial Forest Chemist, who will investigate the chemical properties of the soils and of the produce of forest.

(*vi*) An Imperial Forest Economist, who will make a special study of the best methods of rendering forest produce of all kinds available at the smallest cost to consumers, and who will keep in touch with the commerce of India with the view of fostering and meeting the demand for forest products.

2. These officers, in addition to their research work, will each deliver a course of lectures on his special subject at the College, and take part in the training of the students, but the educational work will be mainly carried on by the Assistant Instructors, who, besides their duties in the class-room, will be in personal charge of the students out of lecture-hours and during practical training in the forests. They will be four in number, and will usually be selected from the Provincial Forest Service.

3. One of the Imperial Officers, who will ordinarily be a Conservator of Forests, will, in addition to his other duties, hold the post of Principal. The members of the staff, who will be *seconded* on their respective lists, will draw the pay, substantive or officiating, to which they are entitled on those lists, together with the following local allowances :—

	Rs Per mensem
The Principal	200
The other Imperial Officers	150
The Assistant Instructors	75

J. WILSON,
Secretary to the Government of India.

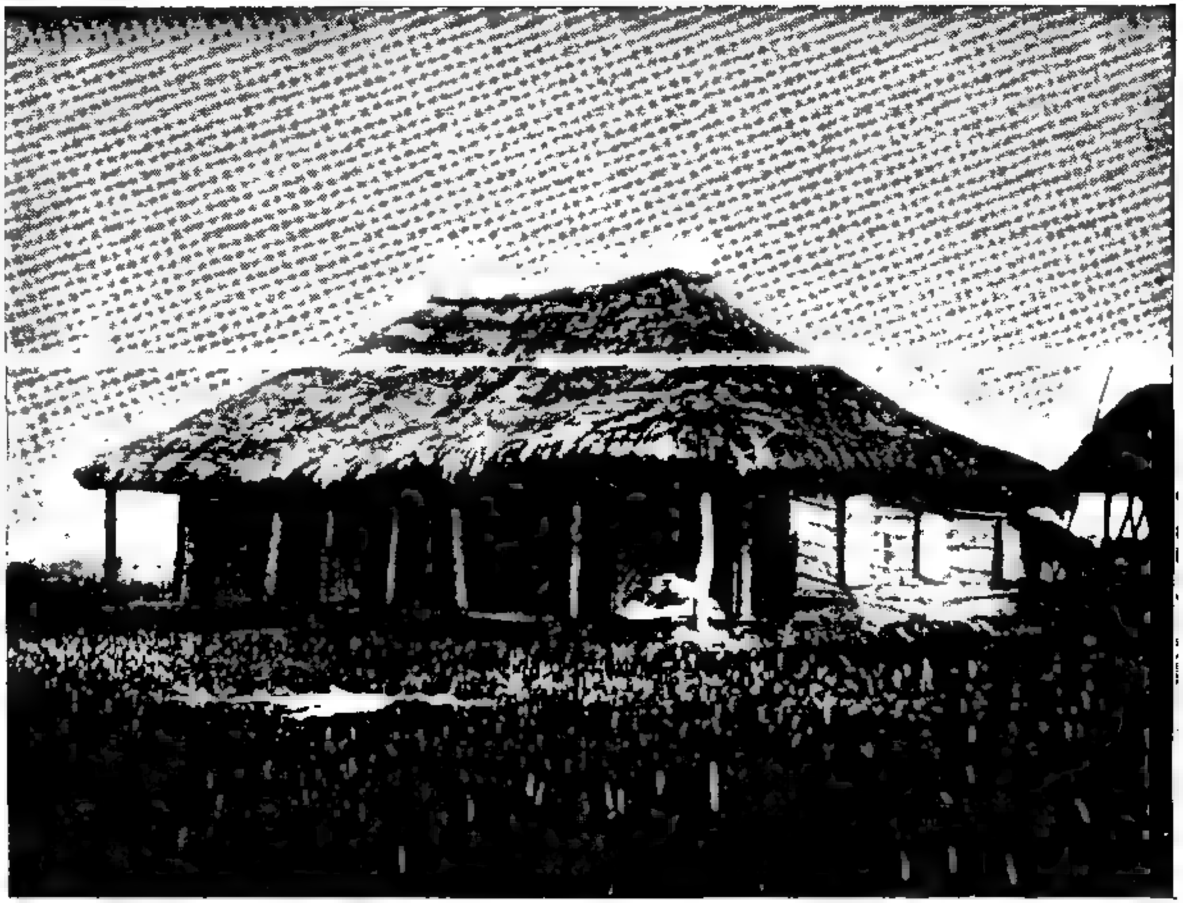


Photo.-Mechl. Dept., Thomason College, Roorkee. Photo by W. F. Perree.

SHOVAIGHAR FOREST REST-HOUSE.
Goalpara Division, Assam.

VOLUME XXXII NUMBER 7

INDIAN FORESTER

JULY, 1906

WORKING PLANS FOR CANTONMENT FORESTS.

In several parts of the country the boundaries of the Military Cantonments enclose an area of considerable extent. This land was originally taken up either to allow for a subsequent increase in the strength of the Garrison, to prevent the encroachment of bazars or to provide space for grazing, etc. In many cases the Military Cantonment included enforested areas which have since been entirely cut out, a process often followed by denudation and erosion which has at length the permanence of the Cantonment. A typical example of this is the Jelapahar and Katapahar Cantonment above Darjeeling, now being replanted by the Forest Department. Other Cantonments on the other hand still contain considerable and valuable areas of forest within their boundaries, but these are in many cases rapidly disappearing owing to the absence of any trained supervision for their conservation or professional knowledge on the part of those responsible for their protection. That the need of affording proper protection to such areas is an urgent one needs no insistence upon here. A knowledge of the real meaning of forest conservancy is becoming so

general that it is fully recognised that it is impossible for indiscriminate hacking or unlimited grazing to continue indefinitely in a forest without that forest entirely disappearing and in most cases leaving behind it a bare desert or at most a crop of useless scrub jungle or coarse unpalatable grasses. In the cases where heavy grazing by goats and camels is allowed to continue unchecked even these latter will disappear, leaving a desert where once a well-wooded countryside had been.

The question of protecting and properly looking after the Cantonment Forests in India has received the attention of the present indefatigable Commander-in-Chief in India and we understand that Lord Kitchener has asked for Working Plans to be drawn up for such forests throughout the country.

This demand is an interesting one in view of the recent issue of a small pamphlet in America entitled "A Working Plan for the Forest Reservation of the United States Military Academy Army Post at West Point, New York." This plan was prepared on the recommendation of the Superintendent of the Military Academy that the lands of the reservation should be placed under systematic management. The plan drawn up, Mr. Pinchot writes, was adopted exactly in accordance with the text. This satisfactory state of affairs cannot be looked on otherwise than as most complimentary to the United States Forest Service, when it is remembered that in these cases there are inevitably so many interests, often somewhat antagonistic, involved We propose here to briefly glance at this plan in the belief that the information may be of considerable use to those responsible for Cantonment *Forests in India.*

An examination of the land at West Point showed that the greater part of it would always be more valuable for the production of wood crops than for any other purpose.

The forest had suffered the usual mismanagement of all timber lands not under regular professional conservation. Most of the area had been cut in Revolutionary times. Until about 1875 cuttings in the second crop were made at irregular intervals. Since then no regular cutting had been allowed. An occasional

tree was cut for special uses, but the character of the forest had not been changed thereby. The more accessible parts were cut over first, and in consequence those areas nearer the Post are the oldest and best. Only a very few small areas have escaped cutting and these occur in the deep ravines, where the cost of getting out the timber was too great to make the operation profitable

The first concern of the preparers of the plan was to ensure the future protection of the forest. It is absolutely necessary that all fires be kept out of this forest. Otherwise it will be useless to attempt an improvement of the present conditions. Ground fires are the direct cause of the scant, dry soil, the absence of seedling reproduction, the unhealthiness of the trees, and the deplorable sylvicultural condition of this reservation.

There is hardly 100 acres on the whole tract that has not been burned over within the last ten years One fourth of the area is burned over annually. They have been only ground fires, to be sure, which burn up the dead litter, but their recurrence year after year has made each season's fires more harmful than the last, inasmuch as the trees have gradually been debilitated and less able to resist injury. Large scars are burned into the trunks and roots, and each year grow larger, until finally the tree dies and adds fuel to the next fire's flames.

The loss of the trees actually burned, however, does not compare with the loss in productive capacity which the soil sustains. The loss is two fold : first, directly, in the burning of the humus and the humus making vegetable matter, and second, indirectly, in destroying the ground cover, underbrush, and leaves which protect the soil from the drying winds and the sun. Now humus has a great capacity for taking and holding water, thereby acting as a sponge reservoir and lessening the total surface evaporation and waste of moisture. Further, the organic compounds of nitrogen formed by the decomposition of litter are the chief source of supply to the tree; and when leaves and forest litter are burned all the nitrogen (which is the most important factor as a food material) is volatilised and passes off in gaseous form. Another serious result is the loss of carbonic acid. While the atmosphere

itself contains enough carbonic acid to keep the trees alive, they must look to the soil for nearly half of the supply needed for their best development. With the supply of nitrogen and carbonic acid cut off, it is readily understood why a forest soon reaches the condition at present prevailing on much of the West Point tract. The humus also acts as a seedbed for the germination and growth of seed, and without it satisfactory seedling reproduction cannot be expected. These conclusions are all shown plainly by the difference in condition between forest areas which have been frequently burned over, and those which have not.

The prevention of these fires is one of the most difficult problems confronting the forest administration. They occur in the spring before the trees have put out their leaves, and in the autumn when the ground litter and leaves of the fall before are thoroughly dry. Matches and lighted cigars thrown upon the ground, it is believed, start most of the fires. The inhabitants in and about West Point have no appreciation of the damage done, and are therefore very careless in this respect. Little notice is taken of small fires until they reach the uncontrollable stage, which, if there is any wind, occurs within an hour after starting.

It is almost incredible how rapidly a small fire, started perhaps by a cast away cigar, match or hot ashes from a pipe, spreads, throwing out sparks, which are blown by the wind to exposed situations and give rise to fresh fires. Fifteen such fires were started in one afternoon in May 1903, at least half of which were in full swing before any organised fight was made against them. In view of these facts it is evident that a regular organised force from the Post must be established which, during the dangerous season, will be available for immediate duty under the direction of the woods-foreman, whenever occasion demands.

The effectiveness of fire lines, even when not previously cleaned out, was well shown in the fire mentioned. Back fires were started from the roads towards the approaching fires, and in this way two or three men were able to effectually check a fire that forty men could not have stamped out in the old way. Wherever the roads

were wide enough and clear of debris, one man to patrol the road and stamp out sparks jumping across was sufficient. The ordinary bran gunny sack was found to be the most effective weapon for sparks and small fires. With proper precautions these small fires should never occur, but if they do, they should be extinguished at once.

This reservation is peculiarly fortunate in having always at hand a large body of able men, under splendid discipline, for occasional immediate service or for regular patrol. A protective service is possible here, which in a private forest would be out of the question.

The proposals for the present treatment are of considerable interest. It is laid down that improvement fellings will be adopted preliminary to the introduction of the regular system of regeneration by progressive fellings. For the first ten years all the fellings will be of the improvement order from which a large financial return cannot be expected. At the end of the ten years' period, however, the forest should be in such a condition that a well-defined and consecutive series of cuttings yielding a sure and definite income may be instituted.

The methods of treatment to be used are set forth in the description of the forest types. These methods may be classified under three heads: first and most important, improvement cutting; second, improvement cutting and underplanting; and third, reproduction cutting.

Improvement cutting consists in the removal of inferior and unlikely trees, which are crowding and impairing the growth of more valuable ones. The trees removed are usually those receiving little or no direct sunlight and are therefore inferior in development to the dominant trees. Their removal gives space for the crowns of the other trees to spread, admits more light to the lower parts of the crowns, and concentrates the soil nourishment upon the trees which are to compose the permanent crop. When the dominant tree is of a distinctly undesirable species or is straggling or crooked, and there is a promising tree of a more desirable species under it, the former should be removed. The amount to

be cut in improvement cuttings, including dead and unhealthy trees, will average from 10 to 30 per cent.

The second class of treatment, improvement cutting and underplanting, will be used on those portions where the removal of all diseased and unlikely trees would result in serious exposure of the soil. The dead and dying trees will be taken first, and the diseased and unlikely trees removed only as fast as is possible without injury to the soil conditions. Wherever these cuttings leave openings in the forest cover, it is proposed to sow broad leaved seed on the better soils of the lower situations, and to plant two year old conifer seedlings on the poorer soils of the higher and more exposed situations. The total amount removed will vary in accordance with the condition of the soil and the amount of diseased timber in the crops. It must be understood that on nearly all of this area the future welfare of the forest requires restocking by seedlings rather than by coppice. For this reason an attempt will be made to provide for and protect natural seedling reproduction in which respect the operation partakes of the nature of a reproduction cutting.

The third class, reproduction cuttings will be begun on only a small part of the reservation during the period of this working plan. But after the improvement cuttings have been completed, reproduction cuttings will be made. The object of the reproduction cuttings is to gradually remove the mature trees in such a way that seedling reproduction of desirable species may be secured and protected. The first cutting is fairly heavy and aims to stimulate reproduction. Cuttings are made thereafter, at intervals of 10 to 20 years, according to the demands of the young crops for light and protection, until all the old crop has been removed. At the end of the cutting period the small areas which have not been seeded by the parent trees are restocked by planting.

In all three classes of treatment, it is absolutely necessary that all the trees to be removed should be selected and properly marked by the forester, since the success or failure of the work depends very largely on the proper selection of the trees to be taken out. It will be necessary to treat each situation as an

individual and distinct problem, and provide such treatment as its particular condition demands.

The following general principles will govern the cutting :-

1. Clear cutting will not be resorted to on any part of the reservation.

2. All dead and fallen timber, and all unhealthy trees shall be removed as soon as the operation is financially possible.

3. Preference in marking for cuttings shall be given to species which thrive best and promise to make the most valuable trees on the particular situation in which they are growing.

4. Trees over 12 inches in diameter shall be felled and cut up into lengths with a saw.

5. Particular care shall be used in felling to do no unnecessary damage to young growth.

6. Stumps shall be cut as low as possible.

7. Timber of a size and quality useful for lumber, poles, piles, posts and sleepers shall be saved for those purposes and cut into proper dimensions; and the remainder shall be cut into 4 foot lengths for cordwood.

8. Branches under one and one-half inches in diameter shall be piled and burned.

9. Cordwood shall be stacked in the woods when felled and hauled out on the snow.

10. All trees to be removed shall be marked distinctly with a marking hatchet on the stump and on the bole 3 or 4 feet up; and rigid inspection of the stumps shall be made after a cutting to ascertain if they all bear the forester's regular mark.

11. The amount of timber taken from each type in each compartment shall be recorded in a book provided for the purpose.

It has been for some time past the earnest desire of the Government of India that all reckless cutting in unprotected forests, the firing of such forests, over grazing, etc., should be put an end to throughout the country, and we believe that most Officers Commanding cantonments are fully alive to the advantages which the prevention of such acts within the forests under their charge will confer. It should now be possible to frame suitable simple working

plans for cantonment forests and Commanding Officers will, we trust, soon be able to obtain thoroughly trained and efficient foresters, using the term in its usually accepted meaning, who will be capable of exercising, under their direct orders, that amount of professional supervision necessary to ensure that the fullest benefits are obtained from the forest areas within their jurisdiction.

The yield may not be high at the start, but proper supervision will ensure an annual monetary return, the revenue being necessarily dependent upon the value of the growth the area is capable of producing, as soon as professional supervision has brought the crop to a normal condition The keenness of the majority of Officers of a garrison on sport and the presence in cantonments of large bodies of trained men are valuable assets towards ensuring efficient protection, once definite rules have been laid down on the subject With efficient protection guaranteed will disappear the most serious of the dangers which these areas have had to face, *viz.*, illicit and indiscriminate cutting, fire, overgrazing and a general total absence of supervision over acts directly injurious to the well-being of the forest. Protection will also result, it may be noted, in an increase in the head of game on the area or, if shot out, in the possibility of restocking the forest with every prospect of success.

SCIENTIFIC PAPERS.

ON POLLARD SHOOTS, STOOL-SHOOTS AND ROOT SUCKERS.

BY R. S. HOLE, F. C. H., F. E. S.

PART I.

Two modes of reproduction, the vegetative and the sexual.

1. In the vegetable kingdom two modes of propagation commonly occur, known as the asexual or vegetative and sexual respectively. In both cases the new individual arises from a minute piece of protoplasm called a *protoplast*, but in the first case "this protoplast does not require the special

stimulus afforded by union with another protoplast, whereas, in the other, in order that a new individual organism may be produced, a *pairing, i.e.*, a union of the substances of two protoplasts, which have come into being at different spots, must take place."*

Yeast fungi.

2. As affording a good example of vegetative reproduction we may select a typical yeast fungus.

The yeast fungi are of great economic importance on account of their power of causing the alcoholic fermentation of sugar solution, a process which, for example, commences at once in the sweet juice extracted from sugarcane, if it is left exposed to the air instead of being quickly boiled, and which we also recognise in the preparation of spirit from the sweet-tasting mahua flowers and in the manufacture of wine from the sugar in grapes. We are not however here concerned with the economic importance of these interesting plants but with their mode of growth and reproduction.

Vegetative reproduction of yeast fungi.

3. Each yeast plant consists of a single minute, oval or spherical cell with a diameter of about $\frac{1}{2000}$ of an inch, which when placed in a suitable nutrient solution, under suitable external conditions of temperature, etc., begins to grow and multiply with great rapidity. The cell-wall bulges out and a protuberance is formed which gradually increases in size, the neck connecting it with the mother-cell remaining narrow. A cell-wall is then formed across the narrow neck at the point of union and the swollen protuberance separating from the mother-cell becomes a new and independent yeast plant, similar to its parent in all respects and endowed with the same power of reproduction or multiplication.

Vegetative reproduction of bacteria

4. Again the great group of plants known collectively as the bacteria which, although exceedingly minute are almost always present in the air, soil and water, and are to be reckoned among the most successful plants in the struggle for existence, have no power of sexual reproduction, and multiply in a manner somewhat similar to that of the yeasts.

* Kerner, *Natural History of Plants*, II, p .

So long as the external conditions are favourable, bacteria grow and multiply very rapidly. Each tiny bacterial cell, whether spherical, rod shaped or curved, having grown to a certain size, becomes divided by a cell-wall into two equal portions and these segments, separating from one another, two distinct individuals are formed, each of which then continues to grow until it has attained the normal size, when it also divides into two, and so on.

The utility of vegetative and sexual reproduction respectively to plants, and the innate power of unlimited life possessed by embryonic cells

5. In such simple organisms as the above all the cells remain *embryonic*, *i.e.* they retain their power of growth and capacity to produce new individuals, and these plants possess in themselves the power of eternal life, death being eventually brought about by unfavourable external conditions, such as the exhaustion of the food supply, the accumulation of poisonous waste substances, extremes of temperature, etc.

Further, from a consideration of such plants we are compelled to accept the truth of the principle that vegetative reproduction may be fully and amply sufficient for the reproduction of the individual plant, *i.e.*, for the preservation of the species. We naturally then inquire why sexual reproduction exists at all. The answer appears to be that the offspring of sexual reproduction as a rule possess characteristics differing more or less from those of the mother plant and which may in consequence be better adapted to survive in the struggle for existence. Broadly speaking, then sexual reproduction may be said to generally favour the production of *new* species.

It is particularly important to note that there is no evidence to show that continued reproduction by asexual methods causes degeneration.

Differentiation of tissues necessary in higher plants.

6. Turning now our attention to the more highly organised plants, and considering the stresses and strains which must arise in the tissues of a large tree for example, it is obvious that these could not possibly be composed entirely of embryonic cells, seeing that such cells do not possess the necessary strength and rigidity. Still

we can recognise the presence of embryonic cells, for instance in the buds, at the various growing points, in the cambial layer and in the young callus tissue which is developed on the cut surface of a wound. However large the entire plant body may be, we know that it has been built up by the activity of its embryonic cells, and these must in consequence possess the power of producing any part of the plant body in which they occur. Thus we are not surprised to find that roots may develop from the callus cells at the base of a cutting and leafy shoots from similar cells on the upper cut surface.

Innate power of eternal life possessed by embryonic tissue and limited life of all differentiated tissue in higher plants.

Although then there is no reason to believe that, in so far as its innate power of eternal life and unlimited reproduction is concerned, there is any essential difference between the embryonic cell which forms part of the vegetative body of a highly organised flowering plant and the cell which constitutes a yeast plant or a bacterium, there is obviously an essential difference between them in the fact that the former is not a distinct individual living an independent existence of its own but a minute unit, forming part of a very complex organism in which the interests of the units must be subordinated to the interests of the organism as a whole.

This cannot be better expressed than in the following words of Pfeffer *:—

"In a well-ordered community every individual is of use and service to the whole, and under conditions which necessitate a rearrangement of the functions of the several members, any given official may be compelled to engage in unaccustomed work and perform duties from which he was previously free. Similarly, in the plant community the activity of every cell and of every organ is subservient to the common weal, and may, when necessary, be modified......so as to fulfil the changed requirements of the whole."

Thus, in a tree, numerous cells are called for the common good to form the rigid supporting heart wood, the conducting water channels, the protecting bark and other parts indispensable to the existence of the tree as a whole.

* W. Pfeffer. *The Physiology of Plants* (Eng. Trans., 1900), Vol. I, p. 27.

Embryonic cells which thus undergo differentiation into organs or tissues with a definite function or work to perform have a limited life, often of very short duration, root-hairs for instance only live for a short time, leaves live for only a few years at longest, while sepals, petals and stamens have a very brief life. The continued existence of plant life therefore depends on the power of unlimited life possessed by cells which retain their embryonic character.

In annual plants the death of the structure we recognise as the plant ensues on the production of the seed. The seeds, however, contain embryonic cells, and the continued existence of the latter renders the maintenance of the species possible. Many trees, on the other hand, are capable of living for very long periods, instances having been recorded in which an age of over 1,000 years has been attained. In the great majority of such old trees, however, the actually living tissue which has risen from embryonic cells and become converted into special tissue or organs with a particular function to perform is at most but a few years old.

Why a tree eventually dies.

7. If, then, we recognise that the majority of trees are able to maintain a number of their cells in an embryonic condition, we are led to inquire why a tree should ever die. So far as is known at present every tree does eventually die.

It is also a well-known fact that after a certain time, varying with the species and localities, as a tree's age increases, its vigour decreases. This is seen for instance in a smaller power of producing fertile seeds or vigorous coppice shoots, in a smaller capacity for healing wounds and in the production of narrow annual rings.

This steadily diminishing vigour means an ever-diminishing power of resisting injurious external influences generally, and the longer a tree lives the more it becomes exposed to such influences which must in consequence sooner or later cause its death.

To take one point of view alone it is clear that the older a tree is the greater becomes the superficial area of living tissue to be protected and the greater become the number of wounds and injuries

it receives which, if not rapidly healed, expose an ever-increasing area to the attacks of injurious fungi.

The reason for this decrease in vigour is not clearly understood.

According to R. Hartig* this must be ascribed "in all probability, especially to the fact that the forces which conduct the water and nutritive materials to the highest bud of the tree are limited in their action, and that sooner or later, depending on the specific and individual nature of the plant, these no longer suffice to provide for the continuance of growth in height."

If we accept this as the primary cause it is not difficult to see how decreasing vigour and ultimately death may be brought about.

Taking the case of a tree, growing in the open which is able to develop its crown normally on all sides as it grows, it is clear that after the attainment of the limit of its height growth, further considerable expansion of the crown and addition to the total area of assimilating leaf tissue becomes a physical impossibility. The total amount of food manufactured by the leaves cannot in consequence be considerably increased after this period, and it is possible that the total amount which can be manufactured in any given period, say a year, may remain practically constant.

Now the essential absorptive organs in the majority of trees and shrubs are the root-hairs. These are formed near the growing tips of the roots and as a rule live only for a few days. In order, therefore, that the needful supplies of water and minerals may be obtained from the soil a continued growth in length of the roots is necessary and consequently there must be a continual addition to the total amount of cambium and living conducting tissue which has to be maintained and supplied with food. There is thus an ever increasing demand for food, and, as we have seen above, any considerable increase in the total quantity of food manufactured is impossible. It is thus not difficult to realise that a time must come when there will be not only no food available for storage as reserves but also not even enough for the maintenance of the

* R. Hartig, *The Diseases of Trees* (Eng. Trans. by Ward and Somerville), p. 7.

cambium in full vigour. The absence of reserves would be manifested by the diminished power of forming fertile seed or vigorous coppice shoots, while the more or less starved condition of the cambium would be evidenced in the less vigorous healing of wounds and in the diminished capacity for forming new tissue as shown by narrow annual rings.

In this connection it is interesting to note that the Banyan (*Ficus bengalensis*), which, by means of the supports provided for its branches by the aerial roots, is able to extend its crown in a horizontal direction to a practically indefinite extent, is probably the most long lived Indian tree.

The influence exercised on embryonic cells in one of the higher plants by the cells and tissues in their neighbourhood may prevent the growth and development of the embryonic cells and may even cause their death.

8. The above considerations, it is true, cannot be held to satisfactorily account for the ultimate death of a tree until the mechanism of water transport in trees has been thoroughly explained, which in the present state of our knowledge is impossible, but they do at all events indicate that in considering the power of continued life and reproduction possessed by the individual embryonic cells of a tree, the question of the reciprocal relations existing between such individual cells and their neighbours with which they are obliged to live in the plant body is one of paramount importance. It appears, moreover, that, both in the case of simple plants like a bacterium or yeast and highly-organized plants like a tree, embryonic cells eventually die if their growth and division is prevented for a long period and thus seeds ultimately lose their power of germination and dormant buds eventually die. The death of an embryonic cell in a tree is consequently assured if the neighbouring cells do no more than refuse to pass on to it the food necessary for its growth and development. The fact that some species of trees do not possess the power of developing either pollard-shoots, stool-shoots or root-suckers, that some readily produce pollard-shoots but neither stool-shoots nor root-suckers, that others mainly produce root-suckers and so on, do not therefore in any way prevent us from accepting the truth of the general principle that all

embryonic tissue is capable of unlimited life and reproduction provided the external conditions are such as to allow of its continual growth, for in such cases the non-development of embryonic cells may be ascribed to the influence exerted upon them by neighbouring cells which, as we have seen, may not only prevent their development, but may be carried so far as to cause their death.

True vegetative reproduction does occur among the higher plants.

9. With regard to the question whether higher plants are capable of true vegetative reproduction we may note the following authoritative statements:

"By vegetative multiplication higher plants can annually give rise to individuals which are strong and capable of flowering and fruiting." *

"Long experience has shown us that the propagation of plants is accomplished with much greater certainty by means of Brood-bodies (all reproductive bodies arising asexually ranging from a single cell to a completely formed plant) than by fertilisation and production of fruit.' †

To illustrate how successful vegetative reproduction may enable a plant to be in the struggle for existence we cannot take a better example than that of the celebrated American water-weed, *Elodea canadensis*, well known for its obstruction to navigation in canals in Europe and which, according to Kerner, "seldom flowers and owes its very remarkable propagation and distribution, not to fruits, but to a quick and plentiful production of off-shoots." ‡

Again, none of us would be inclined to doubt that the plant developed from the tuber of a potato or from the "runner" of a strawberry is identical with the mother plant in regard to its power of growth and development and of forming flowers and fruit.

Very similar to the herbaceous strawberry is the case of the common European shrub known as the bramble or blackberry, the long arcuate branches of which often root at the tips.

* Strasburger. *Text-Book of Botany* (Eng. Trans 1903), p. 277.

† Kerner. *Natural History of Plants*, II, pp. 6 and 70.

‡ Do. *Do.* *Do.* II, p. 457.

The old branches forming the connecting links between the young plants and the mother eventually dying off, independent individuals arise similar to the mother from which they sprang. The same phenomenon may be noticed in the case of *Rubus lasiocarpus* common in the Dehra Dun in India.

(*To be continued.*)

ORIGINAL ARTICLES.

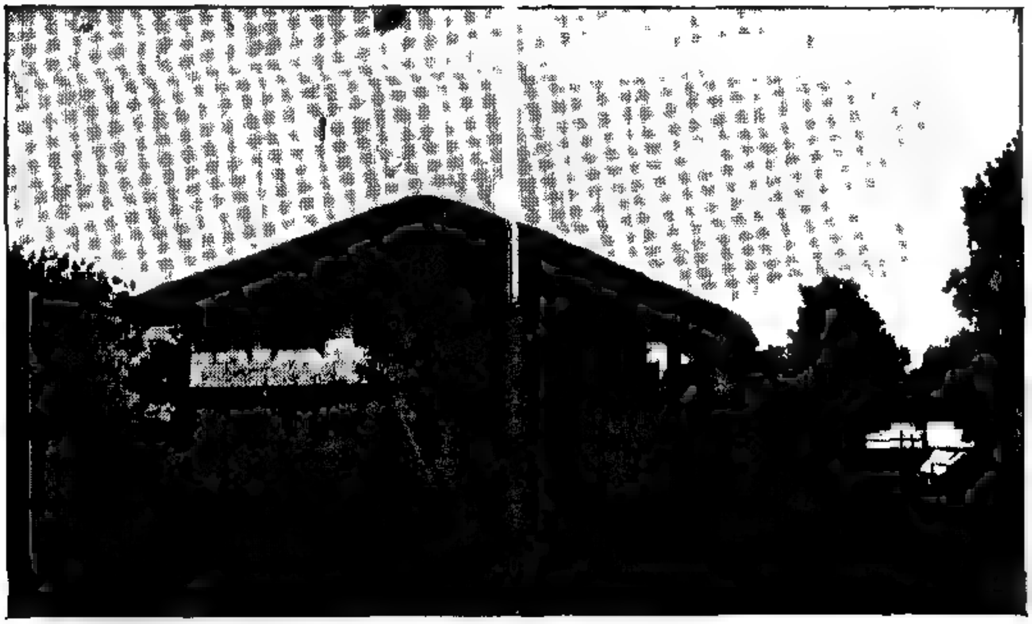
THE EFFECTS OF THE GREAT FROSTS OF 1905 ON THE FORESTS OF NORTHERN INDIA

VII.—THE EFFECTS ON THE FOREST GROWTH OF THE HILL DIVISIONS OF BENGAL.

BY A. L. McINTIRE, CONSERVATOR OF FORESTS

In the hill divisions of Bengal the amount of damage committed by the frosts of 1904-05 was moderate, only exposed seedlings or saplings being killed here and there. Piph (Bucklandia populnea), Lepcha Kaula (Machilus edulis), and in a few places Tun (Cedrela sp. Gamble), or perhaps, in some cases, Cedrela Toona planted too high, were the chief sufferers.

In the Duars and Terai the only damage noticed was the cutting back of isolated "Mallata" (Macaranga pustulata) seedlings or saplings coming up in blanks. In other parts of Bengal damage was confined to the highlands 1,000 feet to 2,000 feet in elevation in the north of the Chota Nagpur division, *i.e.*, in the Palamau and Hazaribagh districts. In such localities sal in nearly all depressions has suffered to a greater or less extent, the damage varying from the killing of the outer twigs only, or of the lower or top branches only, to killing outright down to ground level of trees up to 50 feet or 60 feet high. In the Palamau reserved forests it is estimated that about 15,000 acres, or a quarter of the sal-bearing area, has suffered in this way to a greater or less extent. I have neither heard of nor seen any damage worth considering in Singhbhum or Orissa, though both contain sal-bearing valleys or depressions of which the bottoms are 1,200 feet to 1,600 feet in elevation; even teak was unscathed in Puri and Sambalpur.



CHARDUAR FOREST REST-HOUSE,
Darrang Division Assam.

Photo, Mech. Dept., Thomason College, Roorkee. Photos. by S. Eardley Wilmot.

CHIBUK INSPECTION HUT,
Garo Hills Assam.

TYPES OF FOREST REST HOUSES IN INDIA.

III. Assam.

BY THE HONORARY EDITOR.

In our last article upon this subject we compared some Burma rest-houses with those built for the accommodation of Forest Officers when on tour in the United Provinces. The comparison was not to the advantage of Burma and the illustrations we are able to give in this number through the kindness of Mr. Eardley-Wilmot, Inspector General of Forests, and Messrs. Perrée and Doxat show that Assam is no better off than Burma in the question of house accommodation for touring Forest Officers. This will cause little surprise when it is noted that in spite of the remarks of the Government of India on the subject, an expenditure of the insignificant sum of Rs. 4,373 was considered sufficient in 1903-04 for new construction and repair work to buildings throughout the whole Province, whilst the amount fell to Rs. 3,572 the following year. In the interests of the forest work of the Province, let alone the health of the staff who have to contend with a particularly unpleasant and malarious climate, this short sighted parsimony in the provision of adequate accommodation in the forests cannot be too strongly deprecated. To a Department which yields a handsome annual surplus from the forests especial care should be taken to ensure the continuance and increase of this source of revenue to the State. The saving of the few thousands of rupees which is all that is required for the provision of good houses in the forests has resulted in the past, and must result in the future, in the disablement of a large percentage of the staff through sickness and the consequent loss of their services when they have become most valuable to the Province whose policy is based upon such short-sighted methods. On this subject Mr. W. R. Doxat, a Deputy Conservator who has had considerable experience of the rest-houses of Assam, writes to us: "There is scarcely a single forest rest-house in Assam fit for a Divisional Officer to reside in for any time. There is not a province in India that has shown such a high mortality or such a number of officers who have been compelled to be trans-

ferred on the grounds of ill-health to other provinces. Moreover while the Assam Province is a healthy one for the planters, yet the ill-health among Forest Officers has been abnormal. The reason is not only their arduous and unhealthy work but rather the utterly inadequate provision of rest houses and headquarters' bungalows."

"The photograph of the thatched huts at Chibuk in the Garo Hills occupied during the past cold weather by the Inspector-General of Forests whilst on tour, to whom we are indebted for the illustration, is typical of the accommodation of this nature provided for Forest Officers in this Province. Mr. Eardley-Wilmot informs us that the huts are in a small clearing in a forest of sal where bamboo is also well represented. They are situated half way between Damra and Dambu. Mr. Doxat has kindly sent us, amongst other photographs, the illustration of the forest rest house at Damra. He writes, 'Damra is one of the most notoriously unhealthy range headquarters in Assam. The rest-house consists of two rooms with a mud plinth and bamboo matting on the floor; the windows and doors being plain wooden shutters without any glass. The range quarters are merely sheds'."

The rest house at the Charduar Rubber Plantation, of which Mr. Eardley-Wilmot sent us a photograph, is amongst the best at present existing in the Province. It was erected by the Public Works Department in 1887—88. I have not been able to procure the cost price but the appearance of the bungalow proves it to have been greater than the sums allowed to the Divisional Forest Officer. It is a wooden house built on piles some 8–9 feet above the ground level and consists of three rooms, 17′ × 16′ and 12′ 8″ in height, with two bath-rooms, 8′ 6″ × 8′ 4″, and a godown, with plank floors, a thatch roof, bamboo matting walls and a front verandah 48′ 7″ × 7′. The wood used is all sal, the walls consisting of a wooden frame work filled in with *ekra* (reeds), plastered over and whitewashed. The great defects of the bungalow are to be found in the windows and floors. The former are merely wooden gin mills which have to be shut in windy wet weather, the interior of the bungalow being then in darkness. The addition of glass

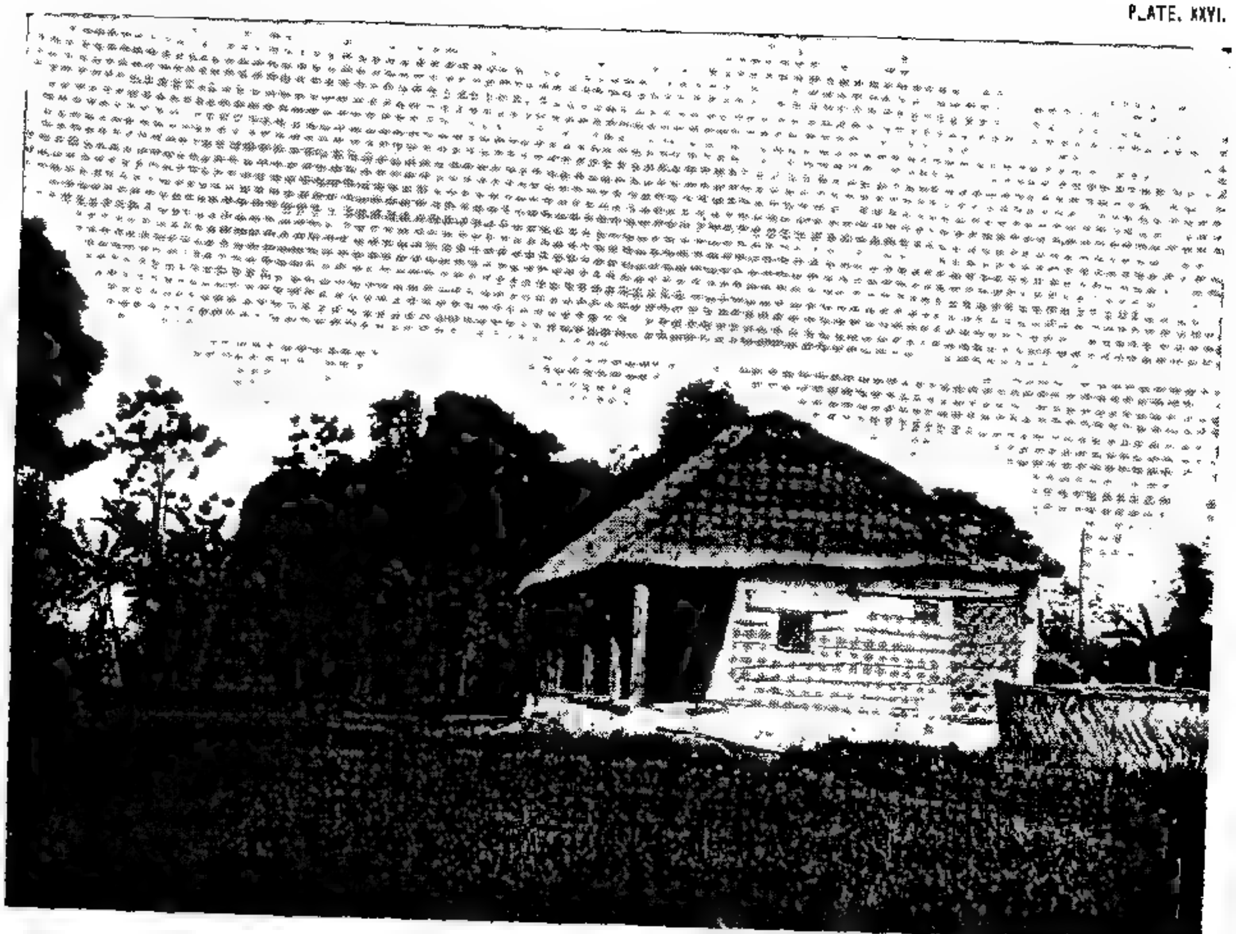


Photo. Mech. Dept., Thomason College, Roorkee

Photo. by W. F. Perree.

HALTUGAON FOREST REST-HOUSE.

Goalpara Division, Assam

windows would not, we believe, cost a large sum of money, and it would be then possible to read and write in the bungalow in bad weather. The second defect is the clumsiness exhibited by the carpenters who put down the flooring, broad spaces having been left between the planks through which the wind blows and damp gets in

The remaining illustrations depict various rest-houses in the Goalpara Division. On these Mr. W. F. Perrée has kindly given us the following note :—

"The Jenali inspection hut is typical of the accommodation provided for Forest Officers up to a comparatively few years ago. It is situated on the Trunk Road and consists of a grass hut with two small rooms and two bath-rooms and a small verandah in front, the floor is of earth raised a few inches above the general level. A mat of 'nal' covers the earth floor. The dilapidated state in the illustration is due to the attempts of wild elephants to pull down the hut. The Patgaon bungalow built in 1900-01 is typical of the newer type of inspection house. This was considered to meet all requirements and came within an ace of being made the standard plan for the whole Province. The floor is of earth raised about three feet above the general level. The walls are of ekra plastered with mud and whitewashed. The accommodation consists of two rooms each 16′ × 16′, two bath rooms each 8′ × 8′ and two verandahs 8′ × 32′ and 8 × 16′. The Haltugaon rest house is also on an earth plinth raised 2 to 3 feet. The entire structure is of rough hewn timber, reeds and grass, the walls are mud plastered and roughly whitewashed. The materials are held together by means of cane and there is no nail or peg in its whole composition There are three rooms each 10′ × 10′, two bath-rooms each 5′ × 10′ and verandahs each 5′ × 30′ and 5′ × 10′.

"The inspection bungalow at Shovaighar (*frontispiece*) is an example of the more luxurious type of building in use many years ago. The plinth is of earth raised ′ or 2′ above the ground. The materials are fastened together with cane or jute string. The walls are mud plastered but not whitewashed. There are three rooms each 16′ × 16′, two bath-rooms 12′ × 8′ and verandahs each 48′ × 8′ and

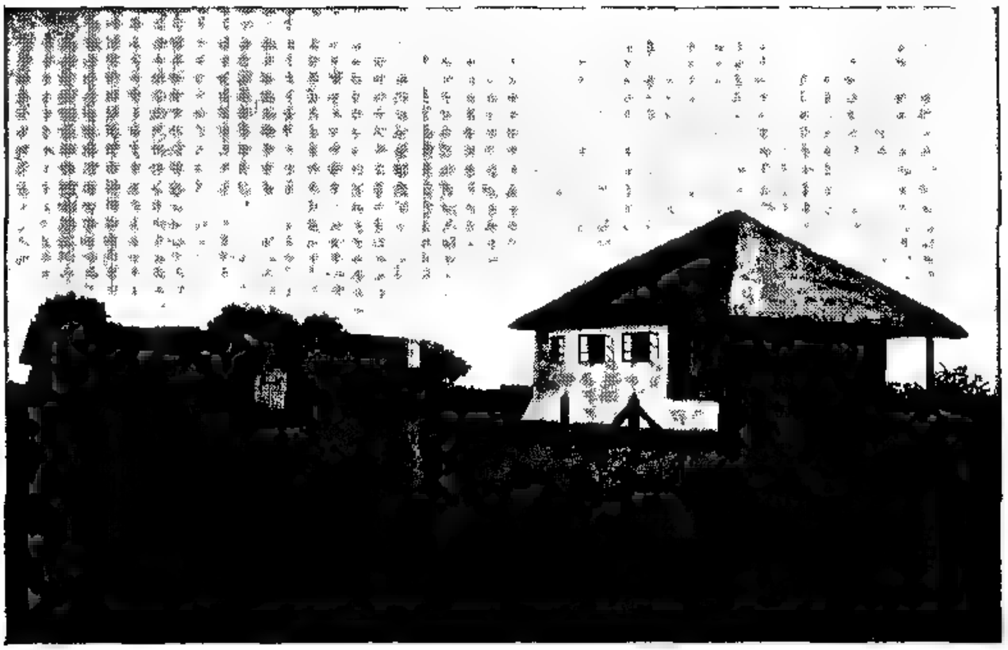
$24' \times 8'$. Like the houses at Jonali and Haltugaon the doors and windows of this house are of bamboo mats which slide on a horizontal bamboo to which they are suspended. In the cold weather the cold penetrates through the numerous chinks and improperly closed doors and windows, while in the hot weather the absence of verandahs at the sides and the smallness of the rooms renders the heat intolerable.

"The inspection bungalow at Jam Duar is beautifully situated where the Sankos River debouches from the Bhutan Hills. It is one of the best in the district. The floor is planked, raised about 4½ ft. above the ground and there are two rooms each $12' \times 16'$, with two bath rooms $8' \times 6'$ and two verandahs each $6' \times 16'$ and $6' \times 32'$. The addition of a third room at the outset and the erection of larger rooms would have made a fairly comfortable house.

"The buildings in Goalpara are, with a single exception, of the cheap and nasty type. Every consideration has always been subordinated to cheapness. There have been great difficulties in the past in procuring labour, but that was largely due to the petty nature of the works failing to attract skilled labour.

"Permanent roads are absent, so that transport of camp kit has always been by elephant. The Divisional Officer, limited generally to two elephants to carry his camp when on tour for a month or more, was unable to add tents to his impedimenta; consequently temporary grass huts were mainly used. A few inspection bungalows were constructed at central points, but the number of such houses was very small, while, as above stated, the money laid out was always insufficient to construct a comfortable house."

The writer can speak from recent personal experience of the great disadvantages and extreme inconvenience in the hot weather of several of the above described and other rest-houses in this province. A glance at the illustrations will make it evident that with such accommodation the touring officer must find it a difficult matter to cope with his official correspondence under conditions so entirely at variance with those to which a man of his training and



NSPEC ION BUNGALOW (FOREST) AT PATGAON.
Goalpara Division, Assam.

Photo.-Mechl. Dept., Thomason College, Roorkee Photo. by W. F. Perrée.

FOREST INSPECTION HUT AT JENALI.
Goalpara Division, Assam.

upbringing has been accustomed. A man cannot produce his best work in surroundings of absolute physical discomfort and which result in undermining his health.

Under the great impetus to efficiency all round which is resulting from the formation of the new Province, the Department in Assam may look forward, we feel sure, to a great amelioration in its touring facilities and we trust that that greed for revenue at the grave risk to health and real efficiency which has been a tendency of the past will no longer form a feature of the future forest policy of the Province.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

IN OKAPI-LAND

Of late years the ambition of every British sportsman in Africa has been to bag an Okapi, as well as to observe this animal in its native haunts, and there to endeavour to obtain some clue as to the reason for the style of colouring which renders this animal so peculiar and remarkable. Although this praiseworthy object does not appear to have been actually realised, it has been nearly approached by Captains Alexander and Gosling during their expedition to Congoland. Neither of these gentlemen seems to have seen the Okapi alive, at all events in freedom, although Captain Gosling is stated on one occasion to have got quite close to an individual, which was, however, unfortunately concealed by the dense vegetation among which these animals habitually dwell. The Portuguese collector of the party was, on the other hand,

more fortunate, and if he did not actually see the animal in its untrammelled surroundings, he must at any rate, it would appear, have seen it alive in the pit in which it was captured. The fact that these animals can be taken in this manner without any very great difficulty, again raises the question whether there is any possibility of a live Okapi ever being seen in Zoological gardens The transporting of such a tropical forest creature to Europe would, however, be a matter of extreme difficulty ; the food question alone being one which would seem to be almost insuperable. If any attempts in this direction were made, and a couple or so of specimens captured, undoubtedly the best chance of keeping them alive in captivity, if the dangers inseparable from the voyage were overcome, would be to place them in the Calcutta "Zoo" rather than in the establishment in the Regent's Park where such animals would almost certainly die within a comparatively short period after their arrival.

Supposing the practicability of capturing an Okapi or two were to be definitely ascertained, it would be worth the while of the authorities of the Calcutta Zoo to give the matter their best consideration. As to finance, the City of Palaces would, we feel sure, take care that there should be no difficulty on that point, if the proposal were found to be within the scope of "practical politics." A trip to India to see the live Okapi would be a fine advertisement for shipping companies.

Undoubtedly the most interesting part of the account sent home by Captains Alexander and Gosling is the description by the latter gentleman of the haunts of the Okapi, for hitherto we have had but one, which is by no means complete, and was also "made in Germany." It was high time that something was done in this way by Englishmen, and therefore the following notes by Captain Gosling, which we quote in full, are of the greatest interest :—

"The Okapi here," writes that gentleman, "is generally found singly or in pairs, but Mobutti hunters state that sometimes three may be found together. An essential to the life of the Okapi is a small stream of water with some muddy and swampy ground

on either side. In this grows a certain large leaf that on its single stalk attains a height of 10ft It is the young leaf of this plant that is the favourite food of the Okapi, and I venture to say that where the plant is not to be found the animal will not exist. During the night he will wander along in the mud and water in search of it. Her he may be found feeding as late as 8 A.M. in the morning, after which he retires to the seclusion of the forest, where he remains till nearly dusk. On the three occasions that I was at close quarters with the beast he was perfectly concealed in this swamp leaf."

The Alexander-Gosling Okapi is to find a home in the Natural History Branch of the British Museum, where the species (for we do not believe there is more than one) is at present represented only by the two strips of skin sent home by Sir Harry Johnston, which gave the first clue to its existence, by the mounted female obtained by the same gentleman, and by two skulls of females and the cast of one of a male It is much to be hoped that the new specimen belongs to the latter sex. *The Indian Field.*

Photo,-Mechl. Dept. Thomason College, Roorkee. Photo. by C. Bruce.

TEAK REGENERATION IN THE NAMME RESERVE,
RUBY MINES, UPPER BURMA.

VOLUME XXXII NUMBER 8

INDIAN FORESTER

AUGUST, 1906.

THE SECRETARY OF STATE AND THE FOREST DEPARTMENT.

CESSANTE CAUSA, CESSAT ET EFFECTUS.

A month or two ago it was our pleasing task to allude to the graceful and eulogistic references made to the work of the Forest Department by members of the Council of the Governor-General and by the Viceroy himself during the debate on the Indian Budget. The remarks on the subject of the position and progress of the Service were pitched in no uncertain key and we think that the Service as a whole was justified in being well content with the praise so liberally bestowed. It was also, perhaps, permissable to feel that the words uttered were spoken with a set purpose and implied an assurance that the satisfactory progress made in the past would not be hindered in the future. It is no secret that the Government of India have under consideration not only the increase in establishments absolutely essential to keep pace with the rapid progress being made, but that their full sympathies are also on the side of improving the present and future prospects of a staff whose work, performed in solitude without murmur or complaint has so

entirely won their commendation and of whose importance to the State all are now so fully agreed upon

This position of affairs was alluded to in the leader last May and our readers may be reflecting upon the dubious value of referring to the matter again after the lapse of so short an interval. The reason will, we feel sure, excuse the repetition. Although the last budget debate in the Governor-General's Council so fully expressed the Government of India's opinion upon the work of the Department in charge of their valuable Forest Estate, we could not but feel that the present Secretary of State was an unknown quantity; that his views on the subject might not coincide, for unfortunately there have been occasions when the views of a Secretary of State have not coincided with those of the Governor General's Council. In these instances, although *causa latet, vis est notissima* and is by no means always appetising to our, perchance perverted, Indian palate.

We have all read Mr. Morley's great speech, for great we think it is entitled to be called, since to fill six columns of the daily papers with graceful literary periods on so dull a subject as a Budget speech is a feat of no mean nature and marks the man of no small mental calibre. We are not here concerned with the several political (and therefore controversial) aspects of the speech. *Cum multis aliis* Mr. Morley alluded to the great work the State undertook in India. "In India the State undertakes not only railways, but other gigantic operations for the direct development of the economic resources of the country. It constructs railways and canals; it conducts irrigation operations, it conserves forests. The net revenue under the three heads of railways, canals and forests five years ago was only £2,750,000. What is it to day? £5,000,000."

It has become a matter of common knowledge, a knowledge learned by painful practical experience in Nature's workshop, that the maintenance and safety of canals, irrigation, the rivers (the main water supply of the country) and consequently of its chief industry, agriculture, are entirely dependant upon the forests being under the highest and most skilled supervision that money can

procure. For the results of the faults committed by a couple of generations of unskilful Foresters would inevitably fal , half a century or so hence, with a terribly heavy hand on the country at large. That the Secretary of State is fully alive to this fact *and has fully realized the good work of the Department and the* great value of the State Forests in times of famine and other distress and as a source of supply for the daily wants of the people and of revenue to Government, his graceful and gratifying allusions to the work of the Department must make apparent to all.

Mr. Morley said : "The State Forests of India cover an area of 250,000 square miles and 660,000,000 cubic feet of timber from the State forests have been extracted, and there has been an increase in the forest revenue in five years of more than £600,000. I cannot wonder that those who are concerned in these operations look forward with nothing short of exultation to the day when this country will realize what a splendid asset is now being built up in India in connection with these forests." That that day is approaching, that it is probably much nearer than many who have not given the subject careful consideration would dream of, those connected most closely with the Department in India are perhaps in the best position to know. We are not here, however, so much concerned with that aspect of the matter as with the far more important and satisfactory fact that Mr. Morley's generous tribute and appreciation indicate that he also has understood the immense importance of her Forest Estate to India. With such a recognition publicly avowed we think the Department may look forward with some confidence to the sympathetic attitude of the *Government of India meeting with a ready response at Home.* We publish in this number a letter from a distinguished correspondent who bears *clarum et venerabile nomen gentibus.* We are not, we may say, in entire agreement with all that the writer says, but we recognise, equally fully with himself, that to get good men, and we now require good men and men with the best scientific training procurable, we must be prepared to pay for them. With the Secretary of State, the Viceroy and the Members of his Council who have been connected with Forest work in the country in accord it

is not too much to hope that the steps taken to remove present discontent, and its invariable accompaniments (for we cannot shut our eyes to the presence of these) slackness and loss of keenness, the inevitable results of stagnation of promotion, heavy work and poor pay, will be on a liberal scale commensurate with the requirements of the case. The Department has the ripe and mature experience of those at present responsible for the organization of the Service at its back and a sympathetic Secretary of State. For ourselves it will be necessary to bear in mind the words of our head line *cessante causa, cessat et effectus.*

SCIENTIFIC PAPERS.

ON POLLARD-SHOOTS, STOOL-SHOOTS AND ROOT SUCKERS

BY R. S. HOLE, F.C.H., F.E.S.

PART II

10. Having cleared the ground to some extent with these preliminary remarks, we must now pass to the immediate subject of the present paper.

How pollard-shoots, stool-shoots and root-suckers develop

When a tree or shrub is felled, new shoots may arise—

(*a*) From dormant or adventitious buds developed on the remaining portion of the stem

(*b*) From adventitious buds developed on the roots.

When the stump of the tree is high and the shoots arise at some *distance from the ground*, we usually call them pollard shoots, whereas if the tree is cut low and the shoots arise close to the ground they are called stool-shoots or coppice shoots, while, finally, the shoots springing from the roots are termed root suckers.

In all cases the buds from which these shoots arise consist largely of embryonic cells

Pfeffer quotes a case in which an entire normal plant was developed from a fragment of the suspensor of an *Orobanche* embryo

and there is no *à priori* reason for believing that, under suitable external conditions, the embryonic cells contained in the above-mentioned buds are incapable of reproducing the entire tree body in which they occur or in other words, that true vegetative reproduction cannot be effected by such buds, provided that they have not lain dormant for too long a period and that they are separated from and become independent of the main body of the parent plant

Root-suckers may become entirely separated from the parent plant.

11. Taking the case of root-suckers first it is, I think, generally accepted as a fact that they may become independent of the mother tree and develop into strong and healthy trees similar in all respects to the parent. With regard to European experience, we may note the following opinion of Kerner's who, when discussing the case of an aspen which had been felled and produced root-suckers, says

"For the most part the roots, after giving rise to a series of shoots, died and decayed, whilst the shoots developed into separate and independent trees, each furnished with roots of its own, so that they look as if they had been deliberately planted in the earth in rows. As a matter of fact, however, the aspen itself produced these saplings from its subterranean portions, and planted them out thus not only renewing its own youth but multiplying.* At first the shoots appeared one by one, then by dozens, and at last by hundreds, at a time. They grow up into trees, and now, instead of the single aspen, there is a little wood composed of trees." While regarding this method of reproduction generally he states : "Not only a great number of trees, but also many shrubs, and a host of herbaceous plants, great and small, exhibit this kind of revival and multiplication, and for many species it is the safest and most fruitful mode of reproduction." * We may also note the following quotation from Boppe given on p. 313, Vol. XXX, of the *Indian Forester* : "The root-shoot frees itself easily from the parent root, to form an independent stem ; better than the stool-shoot, it assures the reproduction and expansion of the tree."

* Kerner, *Natural History of Plants*, II 25—27

12. That in the case of several of our Indian trees the root-suckers may at an early age become separated from the roots of the parent tree, and thus entirely dependent on their own root system, is shown by the observations of Mr. G. M. Ryan, who on p. 451 of Vol. XXX of the *Indian Forester* refers to the suckers of Populus euphratica and notes that they "ultimately acquired a separate and independent existence by the decay and death of the original connecting roots," and again with regard to the suckers of teak he says in the same paper "the connecting subterranean roots * * entirely disappear and this is the case with most species."

Reason to believe that true vegetative reproduction may be effected by means of root suckers.

13. That a root-sucker, which thus soon becomes independent of the parent plant, is incapable of developing into an individual, equal in all respects to the parent, or in other words that true vegetative reproduction cannot be effected by means of root suckers, there appears to be no evidence to show, and in the absence of such evidence, it is as unreasonable to assume this fact as to assert that a strawberry or bramble plant must be inferior to the parent from which it has been separated by the decay of the connecting "runner" or branch respectively.

Importance of root-suckers in Indian forests.

14. We must, moreover, consider the following facts, which now appear to be well established.—

(1) A very considerable number of our Indian trees and shrubs reproduce themselves readily by means of root-suckers *vide* the interesting papers by Messrs. Lushington and Ryan printed on pp. 161 and 450 respectively of Vol. XXX of the *Indian Forester.*

(2) A considerable number of the young shoots which appear after a felling in our coppiced areas are in reality root suckers.

(3) The reproduction by seed of many species, which produce root suckers readily, is often very slow and uncertain, and finally I think we must all agree with Messrs. Lushington and Ryan that in a considerable portion of our Indian forests this question is one of great importance and deserves far more attention than has hitherto been given to it, and as Mr. Ryan justly points out, we must from a forester's point of view, not only consider the great utility of their

method of reproduction, when exhibited by valuable species but also its disadvantages when it leads to the rapid multiplication and successful reproduction of undesirable inferior species.

15. With regard to those suckers which do not become separated from the parent-roots and where more or less of the old root system is supplied with food and kept alive by the suckers, it is of course very difficult without careful experiments to judge how far this condition influences the development of the suckers. Probably in the majority of such cases the suckers, besides utilising the services of part of the old roots, develop a more or less extensive root system of their own, and it should be pointed out that the mere fact of the suckers remaining connected with one another (in the absence, of course, of the parent stem which we assume has been felled) by living roots is not necessarily in itself an abnormal condition which might be expected to cause abnormal development in the suckers, for at p. 267 of *Disease in Plants* under the head of root fusions, Marshall Ward states: "It is regarded as probable in some old forests that the majority of the roots of trees of the same species, are linked up together by such natural grafts," and *F.G.* apparently considers that such root-fusions often occur at an early age, *e.g.*, in the case of seedlings of *Populus euphratica* and teak, *vide* p. 269, Vol. XXXI of the *Indian Forester*.

Root-suckers which do not become entirely separated from the parent plant.

In some of these cases, however, the question of decay spreading from the stool and old roots of the parent appears to be a factor which must be considered. Such decay may proceed very slowly and be confined to the dead heartwood in the older roots, in which case it is probably of very little importance, or it may spread rapidly, in which case it may not only weaken the power of resistance to windfall of the root system of the sucker-tree but may also spread into its stem and thus diminish the outturn of timber.

Finally, when caused principally by a parasitic fungus, this decay may soon cause the death of the sucker-tree. It is, however, worthy of note that injurious parasitic fungi do not appear to

constitute a serious danger in many of our dry Indian forests which are treated as coppice or as coppice with standards. Thus Dr. Butler on pp 487, 488 of Vol. XXXI of the *Indian Forester* says, "Even the jungle is too often dry scrub, the last place in which fungi could flourish," and again when discussing the conditions favourable for the development of fungi says, "I can hardly imagine anything more unsuitable looked at from this point of view than the plains of Northern India from the Punjab to Behar or the bare uplands of the Deccan." Again, in the case of many trees, we know that the production of seed is not possible until a period of vegetative activity has been passed through, resulting in the accumulation of the necessary food materials. It is therefore possible that suckers, springing from old roots in which there are large stores of food materials, are in some cases induced to produce flowers and seed earlier than they would otherwise do and this may in turn result in diminished height growth and longevity.

Necessity for collecting reliable data and obtaining proofs before accepting as true any general statement regarding the characteristics of root-suckers

16. In any case we must recognise that there is an essential difference between a root-sucker which becomes separated from the parent plant at an early age and one which does not do so and we must recognise that careful experiments with our Indian trees are essential before we can accept as true any sweeping generalisation to the effect that root-suckers as a general rule are, as such, necessarily inferior to seedling trees as regards their longevity, their power of height growth or of producing fertile seed or in any other respect. There is, however, no doubt that there is a widespread belief among forest officers to the effect that there is something necessarily abnormal and unwholesome about a root-sucker, and on p. 313, Vol. XXX of the *Indian Forester* we read: "It would, however, perhaps not be wise to induce such reproduction (*i.e.*, of root-suckers) on too large a scale in a high forest if it is really true that the longevity of a tree sprung from a root-shoot is smaller than that of a tree from seed." No one who has watched the rapid establishment of practically pure woods of tendu (*Diospyros tomentosa*) and tinas (*Ougenia dalbergioides*) from root-suckers on

deserted fields in the Central Provinces, in places where reproduction from seed is very unsatisfactory, can fail to be impressed by their possibilities and it appears high time that we set about the collection of data.

The relations existing between stool-shoots or pollard-shoots and the parent plant

17. Turning now to the subject of pollard and stool-shoots which we know are often developed in the place of the original crown of a tree which has been cut off, it appears that they must be burdened with the task of maintaining in full vigour, a more or less extensive root-system with masses of cambium and living conducting tissues. To some extent, at first, the balance of the food materials which were stored away in the tissues, before the tree was felled or pollarded, and which were not required for the development of the shoots themselves, may aid in this task, but it seems certain that, in a short time, the living tissue of the whole tree-body must depend for its food on the supplies manufactured in the leaves of the young shoots. In the absence of definite experiments it is of course impossible to speak positively, but it does, at all events, seem highly probable that the closer the resemblance between the new crown of foliage formed by the young shoots and the old crown of which the tree has been deprived, the better will the new crown be able to do its duty in providing food for the maintenance of the old root system in full vigour.

Cases in which the damage done to the parent plant by coppicing or pollarding may be very slight.

In many cases we know that these young shoots in a few years are capable of forming a crown fully as extensive, if indeed not more so, than that which has been cut away, and we must, I think, conclude that in many cases the removal of the crown has had no permanently injurious effect and in the absence of reliable and often repeated observations, it would be as unreasonable to assert that coppice and pollard shoots are necessarily inferior to seedling trees in their power of height growth and of producing fertile seed, as to say that a young plant which, in early youth, happened to have been cut back by frost or fire or otherwise injured can never develope into a normal tree.

The vigour and size of the young shoots must depend directly on the *quantity of reserve materials available in the remaining* portion of the stem, the roots, or both, of the parent tree, at the expense of which they are produced, but subject to this, it does appear that the younger the tree when felled over, the less injurious is the felling likely to be, for the closer will be the resemblance between the small crown of foliage removed and that formed by the young shoots and the smaller will be the root system to be supported. In the case of young trees also, the small area of the cut surface of the stem is, as a rule, quickly covered by the healthy tissue at the base of the vigorous young shoots and the access of air and water being obstructed, the spread of decay into the root system is to a great extent prevented, which in this case, where the object is to keep the original root system healthy and intact, is obviously an advantage.

As a general rule the younger the plant is when cut over the less injurious is the cutting likely to be.

18. Mr. Leete on pp. 28 and 329 of Vol. XXV of the *Indian Forester* has already drawn attention in the case of *sal* to the resemblance noted on above between a young tree which has been coppiced and a seedling tree, the young shoot of which has been injured by some cause other than felling or which has died back naturally.

Necessity for distinguishing between the artificial removal of a shoot by an external injury and the natural death of the same.

It must, however, be pointed out that the natural annual dying back of the aerial portions of many of our Indian trees in early youth appears to be a necessary part of their normal life history, just as is the shedding of entire branches in the case of the swamp cypress (*Taxodium distichum*) or the shedding of shoots in the case of some species of *Strobilanthes*, and this can therefore be no more compared to the artificial injury induced by coppicing than can the defoliation of a tree by insects be compared to the normal leaf fall. As a general rule, the greater part of the valuable food substances are withdrawn by a plant from an organ before it is shed *naturally* and no open wound uncovered by projecting tissue results.

19. Following up the idea of *comparing* the new crown of foliage with that which has been removed, it appears certain that, in *many* cases, the young shoots cannot adequately perform the duties of the old crown of foliage and that the supply of food made in the leaves of the young shoots, not being equal to the demand, can only provide for a portion of the original root system. Here the damage done and the interference with the normal life history of the tree would appear to be far more serious than in the cases considered above in para. 17.

Cases in which the damage done to the parent plant by coppicing or pollarding may be considerable.

In the case of a tree damaged by drought, the higher branches and tips of the branches first die back, *i.e.*, those parts of the tree situated at the greatest distance from the tips of the roots whence the water-supply is derived. Similarly, in the case of the food-supply from the shoots being insufficient for the roots, we should expect the roots to die back from their tips, those portions dying first which are furthest from the leaves, *i.e.*, the source of the food-supply, and we should expect the damage done to the root system of such a cut tree to resemble, in a general way, that caused by a severe drought in the crown of a healthy tree. In such an injured crown, if the damage has not been too severe, we know that young shoots appear on those portions of the stem and branches which are still alive. These grow and gradually take the place of the dead branches, which ultimately fall off, and, in a few years, the recovery may be so complete that we can see no signs of the damage remaining.

It is probable that a very similar process often takes place in the case of a tree which has been pollarded, or coppiced. In examining the old stools of teak trees which have been felled, I have often found numerous young roots which appear to have developed adventitiously from the old roots.

All appear then here to have a crop of young roots replacing those which died from scarcity of food, just as in the case of a tree damaged by drought we have a crop of young shoots taking the place of those which have been killed. The tree, as it were,

appears to be trying to start life again with a new crop of shoots and young roots.

Different species of course vary greatly as regards their power of recovery from injuries of various kinds, but we should certainly expect that some species, at all events, are, under certain circumstances, capable of recovery completely from even severe damage by pollarding or coppicing, and that they are ultimately able to produce flowers and fertile seed just as a tree may which has recovered from severe damage by frost or drought.

Improbable that the life of the individual plant can ever be materially prolonged by repeated coppicing or pollarding.

20. Assuming that such a complete recovery may be effected we must still remember that any demand made on the powers possessed by a plant of recovering from an injury is usually very harmful if *repeated* (as an instance of which the injurious effects of repeated freezing and thawing may be taken), and it therefore appears highly improbable that the life of a tree can, under the most favourable circumstances, ever be materially increased by *repeated* coppicing or pollarding, and in Europe experience has shown that if ash or maple are repeatedly cut over they often die after the second or third operation.

Effect of the height above the ground at which the stem is cut on the production of young shoots and advisability of pollarding in certain cases.

21. Hitherto no difference has been drawn between what are commonly known as pollard-shoots and those usually called stool-shoots, seeing that, so far as their mode of development and the relations existing between them and the tree body generally are concerned, there appears to be no essential difference between pollard-shoots springing from a stem 6 feet high and stool-shoots borne on a stool a few inches in height at most. At the same time the height at which the stem is cut above the ground often appears to be a factor exercising an important influence on the production of shoots and to which sufficient attention is often not paid. It is, for instance, often stated that *salai (Boswellia serrata)*, as a general rule, produces vigorous shoots with greater certainty if cut at a considerable height above the ground than if cut close to the ground, and it appears that, in some

valuable fuel forests of the Central Provinces, coppicing is gradually exterminating this species. If this is substantiated by careful experiments, the substitution of pollarding for coppice fellings in some of our fuel forests would appear to be a matter of urgent importance. In many cases, coppicing, or cutting low, appears to give the best results with young trees and pollarding, or cutting high, with old trees. This may in part be due to reserve food materials being principally stored in the stem and branches of old trees and in the roots of young trees, and it is suggestive that a stout branch, cut from a *salai* tree too old to coppice, will, if placed in damp soil in the rains, often develop numerous roots from the lower cut surface and shoots from the upper, thus forming a successful cutting.

Pollard-shoots also, situated at some height above the ground are, generally, less exposed to damage by fire and cattle than are coppice shoots springing from a low stool and, in view of these facts, it would appear to be a mistake to endeavour, as is done in some provinces, to enforce a general rule of felling low in village forests, where the demand is chiefly for fuel and small timber and where the forests are much subject to injury from fires and cattle.

On the other hand the spread of decay is perhaps more injurious in the case of a pollard than with a coppiced tree. In the former, decay spreading from the cut surface to the stem would weaken it, make it less able to support a heavy crown of foliage and more liable to damage by windfall, while in the coppiced tree the injurious weakening of the old roots by the spread of decay from the stool would probably be largely compensated for by the improved grip on the soil due to the development of adventitious roots.

(*To be continued.*)

ORIGINAL ARTICLES.

THE REPRODUCTION OF TEAK

BY THE LATE C. BRUCE, F.L.S.

I enclose a photograph taken in the teak forests of the Namme Reserve, Lower Shweli Range, in the Ruby Mines Division.

This forest was once evidently the ordinary mixed teak forest with tinwa (*Cephalostachyum pergracile*) but has been for the last 15 years or so intensively worked by villagers for bamboos. The bamboos being used to raft *In* logs (*Dipterocarpus tuberculatus*) down to Mandalay.

The effect of the continuous and yearly felling of the bamboo has been marvellous, practically a huge improvement felling has been done free and regularly for the last 15 years, the result being that the teak has sprung up in a way that baffles description. I have never seen a teak plantation of any sort to equal some of the groves of Teak Pole forests in the Lower Shweli. The effect on the bamboo also has been no less remarkable; the clumps having gradually been killed out, as the shoots every year get smaller and feebler. In the photograph clumps in a moribund condition can be seen, the vegetation having the appearance of grass being really shoots of bamboo which the weakened clumps have sent up instead of the usual 30 ft stems. The bamboos lying cut are some to be extracted this year, the only ones left in the area photographed.

Both inside and outside fire protected areas the effect is the same, but outside the germination is better.

In the same forests, once away from the areas attacked by bamboo cutters, and inside the fire-protected area, the bamboo is found covering the ground with magnificent clumps, while careful and prolonged search will not enable one to discover one teak seedling which has germinated in the last nine years, *i.e.*, since fire protection was started, while the old teak stools even, which were on the ground previous to the commencement of the fire protection, are being killed off by the dense shade of the bamboo combined with that of other trees.

Photo.-Mechl. Dept. Thomason College, Roorkee.

FOREST SCHOOL VALLAMBROSA

THE ROYAL ITALIAN INSTITUTE OF FORESTRY.

Charmingly situated within easy distance of Florence stands an ancient and romantic Tusean monastery, a building of vast size placed on the northern face of an extensive amphitheatre of mountains, whose summits rise to an elevation of 1,400 metres. Vallombrosa, for this is the home of the chief Italian school of forestry, can be easily visited from Florence in a day, the journey *viâ* Pontassieve to St. Ellero by rail occupying about an hour. Thence a cable railway ascends to Saltino five miles distant, with a gradient of 1 in 5, passing through groves of oak and fertile fields to the Pratomagno range, from which exquisite views are obtained of the valley of the Arno. From Saltino a walk of half an hour through dense fir forest leads to Vallombrosa where in addition to the monastery, now the Forest School, there are two passably good hotels. We are here in the midst of smiling meadows, but to these succeed, as we continue to ascend, forests of silver fir, while the higher summits are crowned by secular beech During summer numerous visitors resort hither, both foreigners and inhabitants of Florence, to breathe the pure aromatic air in the silence of the dense forests of gigantic silver fir.

It was in the solitude of this hermitage that the genius of Milton, steeped in sublime contemplation, drew inspiration for the immortal poem of Paradise Lost

"Thick as autumnal leaves that strew the brooks
In Vallombrosa, whose Etrurian shades
High over-arched embower."

Mrs. Browning, speaking of Milton, writes:—

"He sang of paradise and smiled,
Remembering Vallombrosa."

Here Dante also loved to walk.

The monastery is said to have been founded in the early part of the 11th century by Giovanni Gualberto, a monk of noble Florentine family, and was organised in conformity with the rules of the order of St. Benedict. After its suppression in 1866, a large forest of 1,400 hectares along with 68 farms formerly the property

of the church, reverted to Government and now forms the estate attached to the Forest School.

About the same time the necessity of finding in Italy an intelligent agency, imbued with scientific principles, to administer the forests, inspired the happy idea of founding a school which, thanks to the zeal and intelligent co-operation of its director and professors, has acquired a deserved reputation.

The proximity of Florence, when this city was the capital of the kingdom, suggested the possibility of utilising the monastery situated in this solitary spot for a course of education in forestry, a project definitely realised in 1868.

The Ministry of Agriculture was not slow to recognise the value of these studies, and orders were passed for the establishment of a course of instruction commensurate with the importance of the subject, and adapted to the needs and conditions of the country, on the lines already developed in Germany, France and Austria. Hence the Decree of 1869, approving the fundamental principles of the school of Vallombrosa.

At first the course of instruction was limited to three years, but this was afterwards increased to four. The subjects correspond to those taught in similar institutions in other countries but are arranged with regard to their relative importance to the needs of Italy. During the first three years considerable time is devoted to the study of the French, German, and Italian languages. The sum payable annually by each student at the school is 600 lire equivalent to £24.

On passing out graduates are appointed Assistant Sub-Inspectors on a salary of 1 200 lire or £48, and may rise to the following grades:—

Sub Inspector	3rd	class	on a salary of	1,500	lire	= £		60
	2nd	,,	,,	2,000	,,	,,		80
	1st	,,	,,	2,500	,,	,,		100
Inspector	3rd	,,	,,	3,000	,,	,,		120
	2nd	,,	,,	3,500	,,	,,		140
	1st	,,	,,	4,000	,,	,,		160
Chief Inspector	2nd	,,	,,	5,000	,,	,,		200
	1st	,,	,,	6,000	,,	,,		240

The present Director of the School, Commandant *Piccioli*, an officer of Engineers, is well known in the scientific world for numerous works on Forestry, the latest being his "Boschi and Torrenti," which deals with the planting of areas denuded by torrents.

He has been Professor since 1870 and Director since 1878, and has taken a leading part in framing the forest policy by which the Italian administration is guided. He has also been largely instrumental in creating and developing the first climatic station of Italy, which is now frequented by numerous strangers, and especially by Anglo-Saxon pilgrims to the spot which inspired the English Alighieri.

H. K.

SANDAL WOOD AT KURNOOL.

BY M. RAMA RAO, MADRAS FOREST DEPARTMENT.

I was agreeably surprised to find sandal in all stages of growth up to small poles growing in the compound of the Kolhapur Raja's bungalow in Kurnool town, the tree being associated with Inga dulcis, Melia azadirachta, Albizza Lebbek and other species. The soil is black cotton and moistened by a channel from the Jungabhadra canal. The young sandal forms a regular thicket. I observed a few young poles cut away by the gardener probably in ignorance of the value of what he was destroying, or through sheer carelessness. Before arriving at Kurnool, I had neither heard nor read of the existence of sandal in Kurnool itself and hence my surprise.

Mr. A. W. Lushington has since informed me that the late Mr. Sheffield reported in 1864 that there was young sandal in the Pechernvu plateau covering about 200 square miles, that the wood was scentless, that there were no trees over 4 inches in diameter and that it was much stolen and taken to Hyderabad territory. Mr. Lushington himself found in July 1905 heaps of sandal plants on the plateau but none above 2 inches in diameter. Mr. Sheffield's report

that the wood was scentless was probably based on an examination of young trees which had not developed heartwood. The fact that stolen wood was taken to Hyderabad indicates that there must have been scented heartwood in bigger trees which had disappeared in Mr. Sheffield's time.

Some months ago I was walking along the Tungabhadra canal bank when I noticed between the Hindri aqueduct and the toll-gate on the Kurnool-Dhone road a few sandal trees of fairly good size and partially mutilated crowns growing along the outer foot of the canal bank. On approaching the trees I found the trunks of the largest two of them had been sliced off from the base to a height of about $2\frac{1}{2}$ to 3 feet on the sides *away from* the bank and the wood taken away. The heartwood was well scented and some thief who knew what the trees were must have damaged the trunks. The crowns had been lopped off for feeding goats as I found twigs and branches lying under the trees shorn of their leaves. Officers connected with the canal knew nothing about the existence of these trees or that they were sandal trees until they were told so by me. There were in all five trees including the two above mentioned, which were the largest—one measuring 3 feet 4 inches in girth at base and 33 inches at breast height ($4\frac{1}{2}$ feet from base) and the other measuring 32 inches at a height of 2 feet 9 inches from the base.

In the course of felling the two biggest trees the following points were noticed :—

1. *Soil.*—This is black cotton soil excavated from the canal and thrown on to the embankment. Just outside the embankment the soil is also black cotton, pretty deep and resting on black or grey shale (Kurnool series) The canal which contains water almost throughout the year at that particular locality must have kept the subsoil always moist by percolation.

2. *Elevation.*—This is about the same as Kurnool town which is 900 feet above the sea-level. It is situated at 15° 50′ north latitude and 78° 6′ east longitude.

Climatic conditions.—The average annual mean temperature of Kurnool is 83°—the average maximum of the past five years

in the hottest month (May) being 109·2° and the minimum in the coldest month (December) 49·4°. The average annual rainfall recorded at Kurnool for the past 20 years is 27·48 inches.

Associates.—Margosa (*Melia azadirachta*), Inga dulcis, Albizzia Lebbek, bushes of Anona squamosa, and a few cork trees (*Millingtonia hortensis*) on the top of the embankment and a few babool bushes (*Acacia arabica*). Of the above, Albizzia Lebbek, Anona squamosa, Inga dulcis, and margosa trees were growing very close to the sandal trees.

Root ramification.— In both the trees felled it was noticed that the bulk of the main side roots extended towards the canal; and the few that grew away from it were dead or dying. It appeared probable that the unhealthy and dying condition of the roots of the latter was due to the trunk on their side having been sliced off and damaged long ago. I believe this is due to the descent of the *elaborated* sap being prevented by the loss of bark and sapwood on the damaged side and to the consequent starvation of the roots below on that side. The same or similar reasons may explain the occurrence of *spike* in portions of the crown of a sandal tree while the other portions are healthy and normal.

Whether the large extension of the side-roots towards the canal through the embankment was due to the position of the majority of the hosts on that side or to the moisture in the canal or to both, it is difficult to say without examining the whole root system, which of course it was impossible to do, but I think that these were the main inducing causes

Fructification.—In the first week of January last I noticed only one tree bearing flower buds on a large scale, while in others no inflorescence was observed, but in two of the five trees there were a few ripe fruit which were picked off for sowing. Under the two big trees about two measures of ripe seed were gathered during that week and since sown and found to germinate well. The seed thus gathered must have been shed by the trees during November and December. On the 26th February flower

buds were observed on all the trees except one in which young fruit had already begun to form. As the trees were close to each other this difference is striking and has therefore been recorded.

Natural reproduction.—Both in the Kolhapur Raja's compound and on the canal bank above referred to young sandal plants are found in plenty, although at the latter place the plants have suffered considerable damage from cattle and goats. A few plants were dug up and found to be seedlings. They are chiefly found amidst Anona squamosa and babul bushes. That these young plants are the result of natural reproduction from the seed shed by the larger trees and from their roots there is absolutely no doubt whatever. The reproduction is as plentiful and promising here as in the natural *habitat* of sandal.

The origin of these sandal trees.—I could get no reliable information on this point It may be presumed that it was introduced into the Kolhapur Raja's compound from somewhere. But how the trees on the canal bank came there could not be accurately ascertained. An old Mahomedan woman living in the Mahomedan *kabrasthan* close by the trees informed me that there were a few plants there just before the canal was dug in 1861 or so. But if this were so the plants would have been destroyed during the formation of the canal. I therefore think that her story is hardly credible. Could they have resulted from seed brought down by the flood of the Jungabhadra river which traverses the sandal tracts of the Thimga District in the Mysore Province and those of Hospet Taluq and Tandur State in the Bellary District? If this be so, sandal plants should be found along the banks of the river higher up. This latter surmise seems to be very probable, as I have found sandal plants along the canal bank four miles above Kurnool near Munigulpand, where the village officials informed me that it is found here and there up the canal as far as Sunkesala where the canal branches off from the Jungabhadra.

Points observed regarding *growth and development in the two felled trees.*

Particulars.	*Tree No. 1.*	*Tree No. 2.*
(*a*) Height up to end of woody portion.	28'-3"	38'
(*b*) Girth	32" at 2'-9"	33" at 4½' from base.
(*c*) Concentric rings ...	42 counted at 2'-9" from base.	52 counted at 4½' from base.
(*d*) Height up to which heartwood extended.	17'	30'
(*e*) Average diameter of heartwood.	6"	7"
(*f*) Total yield of scented heartwood.	123* lbs. of which 35 lbs. rootwood.	260* lbs. of which 40 lbs. rootwood.

**N. B.*—The yield would have been much greater had not the trunks been sliced off and taken away. It would be within the mark to add 20 lbs. to each tree as that is the estimated quantity of the heartwood stolen.

The average radius of the transverse section of No. I tree comes to 5·09 inches and that of tree No. II to 5·25 inches. Deducting therefrom 0·25 inches for the thickness of the bark, the radii of the woody cylinders would be 4·84 inches and 5 inches respectively; and this works out to 8 rings per inch in tree No. I and 10 rings in the other. This indicates that the growth of the trees at Kurnool is as good as the sandal trees on the Javadis, if not better.

As regards the yield of scented wood, the output of these trees compares very favourably with that of the trees of similar girths grown on all the hill ranges of the Salem District and also of the North Coimbatore District (*vide* table No 2 on page 7 of my "Notes on Sandal"). It may be here remarked that these two trees had not attained their maximum physical development, and but for the serious damage done to their trunks and crowns they could have gone on growing and developing for a number of years.

The scent of the heartwood was well developed both in the stem and the roots, and appeared to me to be not inferior to that of similar trees grown in the Salem District. In personally undertaking the extraction of scented wood in these trees, my chief object has been to test the accuracy of observations made by some writers on sandal that at low elevations scented wood is not developed, and where it is, that it is very poor in oil. This theory did not appear to me to be correct and I was therefore on the look out for evidence to test its accuracy. The results now obtained at Kurnool prove beyond all doubt that the theory cannot hold water and that sandal does produce heartwood even at such low elevations as 900 feet provided other conditions of growth are favourable.

In the beginning of 1905 having observed some fairly big sandal trees growing in the compound of Mr. Shutie, Principal of the Salem College, I felled two of the largest trees with his permission, one of them was 6¾ inches in diameter with a heartwood ring 3 inches broad. The other tree was 27¾ inches in girth and the diameter of heartwood was 5½ inches. These trees were growing associated with Melia azadirachta, Morinda citrifolia, Zizyphus jujuba, Eugenia jambolana, Streblus asper, mango and tamarind trees. The soil was deep black loam. Salem is at an elevation of 950 feet above sea level. Through the kindness of Mr. A. W. Lushington, Conservator of Forests, Northern Circle, Madras, I received a piece of sandal wood grown in the Ranee Sahib's compound in Vizagapatam not 30 feet above sea level. The wood was scented but faintly, and this latter circumstance is evidently due to its being comparatively young and immature. This piece of sandal wood and a piece grown at Kurnool have been sent to the Imperial Forest College Museum at Dehra Dun; and another piece of Kurnool grown wood to the Coimbatore Gass Museum.

With this positive evidence before us of the development of scented heartwood at such low elevations, I think the cause for non development of scent elsewhere must be looked for not in the *elevation of a locality* but in something else ; and what this latter is

must be ascertained by a careful study of the surrounding conditions. This evidence strengthens my belief already recorded elsewhere *that the associates of sandal play a very important part in the development of scent.*

BASSIA LATIFOLIA GUM.

BY P. SHANKERNATH, FOREST RANGER, CENTRAL PROVINCES.

In 1905 whilst engaged in making collections of various products for the Indian Museum in Calcutta, my attention was drawn to a milky exudation from cuts made in the bark of the Mohwa tree. I was able to collect a small quantity of this gum, and the specimens so collected by me were in due course forwarded to the Reporter on Economic Products to the Government of India Mr. D. Hooper, the Officiating Reporter, was apparently much interested in these samples, and in drawing attention to them he wrote as follows :—

"This gum has the properties and composition of Balata gum or gum Chichla, a natural substitute for gutta-percha, collected and exported in large quantities from British and Dutch Guiana. This discovery is of some interest, and I should be pleased if you could ascertain if this product is available in any quantity and if the trees would bear tapping at the suitable season of the year in order to induce a larger yield of gum. The *Bassia* is abundant in several parts of Northern India and the gum has been occasionally referred to, but hitherto its character has not been determined The samples of gum from your division had the following percentage composition :—

	I.	II.	III.
Moisture ...	3·8	6·7	4·9
Gutta ...	49·5	43·6	46·5
Resins ...	37·5	35·0	37·6
Ash and dirt ...	9·2	14·7	11·0

"I should be glad to have a large sample of this gum for Museum purposes, and any remarks you may have to offer on the collection of the gum as a commercial article."

Accordingly during the past few months I have been engaged in carrying out certain experiments, with results that may be found sufficiently interesting to your readers.

Some 50 large Mohwa trees, growing in more or less isolated positions, in the Government Forest village area of Barwani of the Hoshangabad Division, were selected and marked for experiment and arrangements were made to "*tap*" each of these trees in exactly the same way as pine trees are tapped for resin. Incisions were made into the bark of the tree, and small earthen pots were placed below the cut to collect the gum as it exuded.

The 50 Mohwa trees selected for treatment varied in girth from 3½ feet to 11½ feet, and three different kinds of notches were tried, namely, perpendicular |, slanting \ and V-shaped V. It was soon found that Mohwa trees below 6 feet in girth were of little use, as the quantity of gum exuded was inappreciable; and that the slanting notch, \ gave the best results. Further, the flow of "gum" or milk continues only for about 24 hours after the notch or cut is made. At the end of this time the flow stops and it is not renewed by shaving or scraping or deepening the notch. Moreover, this flow or exudation is more abundant in the early mornings or late evenings after the notch is made, and practically stops in the middle of the day.

Other general results noted may also be briefly alluded to. As might well be expected, trees growing in the open in fields exude larger quantities of gum than trees of the same girth growing in the forests; and the greater the girth of the tree, the greater the quantity of gum obtained. Again, a tree tapped in more places than one at one time gives almost the same total quantity of milk as a tree of the same girth in which the same number of notches are made one by one at intervals of 24 hours, provided the notches are made in both cases at the same height above the ground; a slanting notch made at a height of about 3 feet above the ground giving the best result.

Bearing in mind these details which affect results, it is only necessary now to give a few figures. As above explained, 50 Mohwa trees were tapped, 20 of which were below 6 feet in girth

and yielded little or no gum. The remaining 30 trees exuded gum from each notch in quantities varying from $\frac{1}{4}$ tola to $4\frac{1}{8}$ tolas per notch; the total quantity so collected from the 30 trees being about 80 tolas. In other words, by careful and systematic tapping, to be continued for a series of years, an outturn of about $2\frac{1}{2}$ tolas of gum per tree may be expected under favourable conditions, and provided the trees available are of large girth.

In addition, experiments were carried out to ascertain what would be the maximum quantity of gum that could be obtained from one mature tree by a concentrated process of heavy tapping. Accordingly six notches were made in a circle at a height of 3 feet from the ground, with an interval of about 10 inches between each notch. As a result a quantity of gum varying from $1\frac{1}{2}$ to 2 tolas was obtained from each notch, the six notches yielding $10\frac{3}{4}$ tolas. As soon as gum had ceased to exude from this row of notches, a second row of six notches was made one foot higher, that is, at a height of 4 feet from the ground. These six notches yielded $8\frac{1}{4}$ tolas of gum, the amount varying from $\frac{3}{4}$ to $1\frac{3}{4}$ tolas per notch. Similarly, a third row of six notches was made in the same tree at a height of 5 feet from the ground, but this row only yielded 3 tolas of gum varying from $\frac{1}{4}$ to $\frac{3}{4}$ tolas per notch.

Thus from a single tree a total quantity of 22 tolas of gum was obtained; and this may be taken to represent the maximum quantity that could be obtained from a good average tree in any one year; but naturally no tree could be tapped to this extent annually.

These results from a purely commercial point of view are wholly unsatisfactory, and the verdict must naturally be that *le jeu ne vaut pas la chandelle.* In practice, under systematic working some 20 mature Mohwa trees would have to be tapped to yield an annual outturn of 1 lb of this substitute for gutta-percha. In the *Indian Forester* for April 1906 Burma India-rubber is quoted in the London market at 1*s.* 6*d.* to 3*s.* 8*d* a pound, and this is exclusive of expenses connected with the collection and carriage of the product. The profit, therefore, to be derived from the tapping of Mohwa trees is indeed small. On the other hand in Central India the Mohwa is a tree of the very greatest economic value both on

account of the fleshy sweet corollas of its flowers and of its fruit, full information regarding the uses of this important tree will be found in Watt's Dictionary of Economic Products, *Vol. I, page 406.*

No information has so far been collected as regards the damage that may be done to a tree by tapping, both to the tree itself and to the flower crop. A curious fact, however, has come to my notice whilst carrying out these experiments, namely, that the aboriginal tribes of these forests, the Gonds and Korkus, are in the habit of making a ring of cuts with an axe round the bottom of the stem of Mohwa trees with the object of increasing the yield of flowers.

RESEARCHES ON THE REGENERATION OF SILVER FIR.

BY E. RADCLIFFE KASHMIR FOREST DEPARTMENT.

It was with much interest that I read the article by A. G. H. H. in the May number of the *Indian Forester*. The question of the regeneration of Silver Fir in the Kashmir Valley proper is one of most vital importance as, owing to the position of the forests and the special demand for the timber as firewood for the Sericulture Department these forests are being worked up to, if not over, their yield. As a matter of fact the reproduction of Silver Fir in this valley is perhaps better than in most other Himalayan forests, but at the same time it is not satisfactory. From my own observations there appears to be no certainty with regard to young growth as there is with Deodar and Blue Pine and reproduction is found flourishing in different parts and under, apparently, totally different conditions. No efforts have yet been made to try and reproduce the species artificially, and even if sowings and plantings were carried out the results, as has been the case with all Deodar and Pine sowings and plantings, would be *nil* under the present conditions when the Forest Department has no power to control even grazing in first class forests.

In Gulmarg, where the forests are principally composed of *Silver Fir, the best growth as a rule, is found on stony islands* in streams running through the forests but at the same time

excellent thickets are found on dry open ridges and, rarely, in grassy blanks. Once young trees establish themselves they thrive wonderfully, but grazing undoubtedly kills numbers of seedlings and also stunts the growth of the hardier plants which have survived this drastic treatment. The tree itself is more open to the attacks of fungi than any other coniferous species owing, undoubtedly, to the want of any separate heart-wood and there is no doubt that fungoid growth is more common in these forests than others. The question is whether this growth is natural as it is or whether it is aggravated by the presence of large quantities of cattle manure? Judging from the places in which reproduction is found there appears to be some connection between the two as, generally, reproduction is found on stony islands, where cattle will not usually go, or it is found on steep ridges up which these animals, as a rule, will not climb. There is no doubt that a continuous pure growth of one particular tree must tend, in time, to impoverish the soil for that species in the same way that agricultural crops do, and unless a proper rotation of cropping is taken in hand and, especially, unless some green crop, such as any leguminous plant, is put down, after a certain period the quantity of nitrates in the soil is reduced to a minimum. Under ordinary circumstances in a forest, the chemicals taken up by a tree are returned when the tree dies, but in forests which are being worked the trees are removed altogether, so that the soil becomes more quickly impoverished. In this way the soil is reduced to a weed or shrub producing condition. With regard to the manure theory, there are some weeds which thrive on it especially the Dock which may be seen growing all over ground where cattle or sheep and goats have rested in their wanderings, and such growth effectually prevents any other from coming up even if it would do so in such places, which is highly improbable; there seems but little doubt that this action of manure is gradually getting worse in the Kashmir Valley as herds and flocks increase, which they are doing rapidly in proportion to the number of forests closed in India to grazing. Where there is a collection of fallen trees the reproduction is good, but whether this is due to the presence of returned chemicals

chiefly, or to the fact that these trees act as a barrier to cattle and so the young plants are not disturbed, is a matter which cannot be decided without a special study of local circumstances. Whatever are the reasons for this extraordinary want of regeneration of Silver Fir, which, it must be remembered, is not the case with other coniferous species, the only way to discover them is to place certain similar areas under different conditions and to judge from the ultimate results.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

CONCERNING BONGAS AND FIRE-PROTECTION.

"The Heathen in his blindness
Bows down to wood and stone."

Even granting the full latitude allowed by poetic license to the learned author of the hymn from which the above couplet is an extract, it is not easy to reconcile such an astounding statement with facts. It requires neither the erudition of Nancy nor the training of Coopers Hill to see that in the vast majority of cases, it

is *the wood that bows down to the heathen* and not the heathen that bows down to the wood. A thousand barren hillsides seamed with scoured out watercourses testify to the fact. Yet there is a notable exception to be found almost throughout India. Among the "heathen"—this opprobrious term is none of my making—exist a class who jealously guard the finest groups of trees within their particular villages. These are the Bongas or wood spirits of whom certain enthusiasts from Exeter Hall and elsewhere would have us believe that their existence is a myth. Be this as it may, the Bonga exists for all practical purposes amongst the more intelligent jungle folk of India. Moreover he is a forester, born and bred, and encourages the reservation of trees. My point is that more use might be made of him, and an attempt to do this is being made in this division by extending and fire-tracing his dwelling places. It is obvious that no one who lives in places where the thermometer runs to over 110 degrees can look forward to the addition of fire with complacency! This however our Bonga is often expected to do, but, I think that, if the point were fully explained to his adherents, as well as the fact that his grove will eventually disappear if regularly burnt, a good deal might be done to instruct the said heathen in living up to his reputation as set forth in the hymn above quoted. In any case the experiment costs little or nothing, and it is possible that good may come of it. In common with other people the Bonga is not above the pleasures of the table, and a little sympathy in this direction finds a ready response among his friends, with whom, I regret to say, is not numbered the Accountant General, Bengal, who is inclined to jib at the expense of the feast when entered in the divisional accounts.*

SINGABONGA.

* To those who are not acquainted with the characteristics of the jungle folk alluded to, the following explanation may be of interest. For organising forest villages in the division referred to where labour is scarce it has often been found that the people require to make considerable sacrifices to the presiding spirit of the grove (Bonga-sarni) to ward off calamity and sickness. The Divisional Officer has occasionally found it politic to himself give a goat or fowl to prevent the people leaving the new site. He has not found, however, that sympathetic spirit looked for when charging such items in his accounts.—[HON. ED.

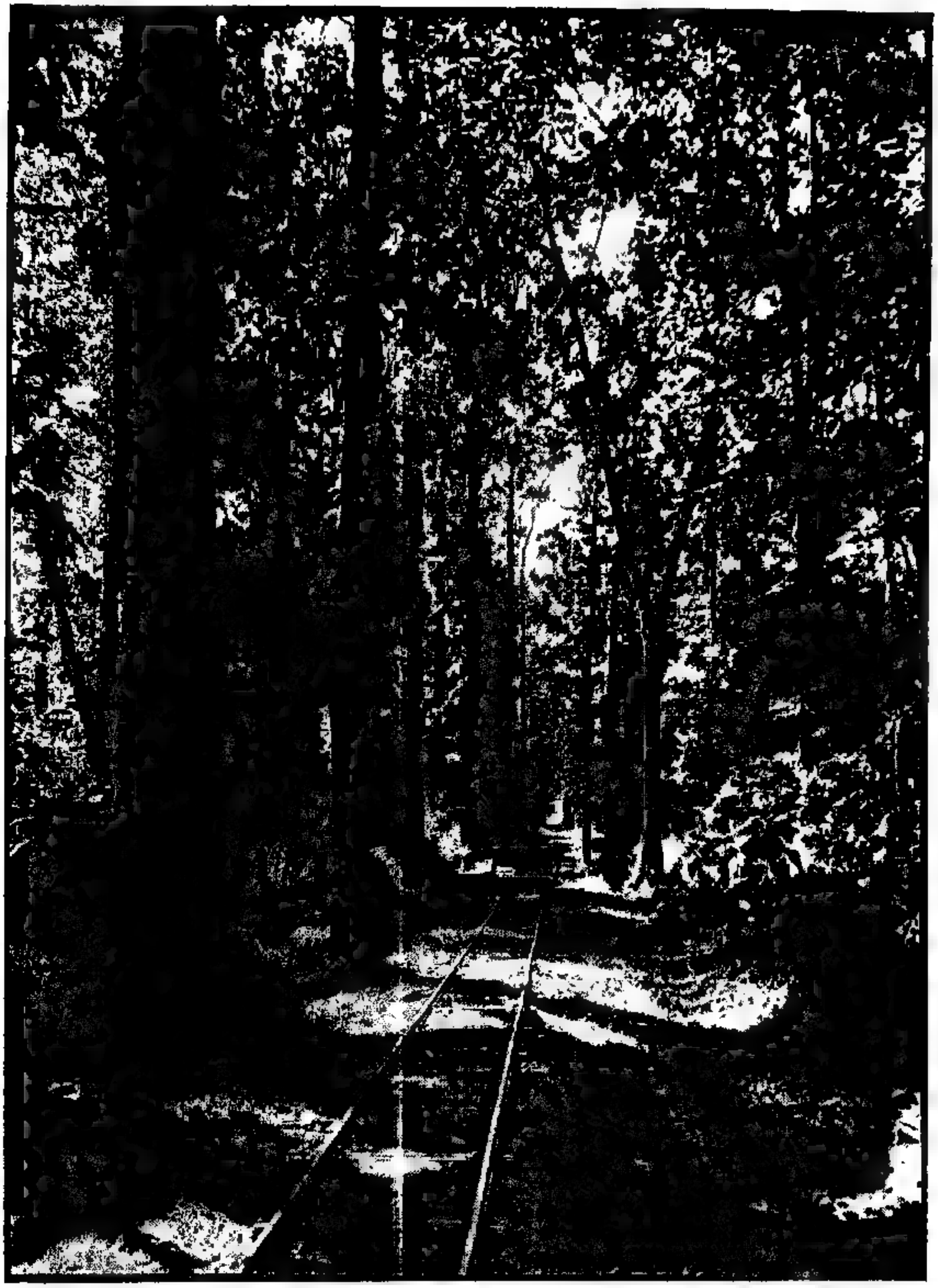


Photo. Mechl. Dept., Thomason College, Roorkee. Photo. by W. F. Perree.

THE GOALPARA TRAMWAY.
(ASSAM).

Frontispiece

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FORESTS AND THE WATER-SUPPLY.

The connection between the forests and water supply of a country is of such an intimate nature that at first sight it is almost inconceivable that its full significance and importance should not be obvious to all well educated men. *And yet it is the general rule* amongst the well-educated Englishman to question this intimate relation. To point his arguments he will instance his own well-watered, damp, cold, misty and richly-rained-upon country.

We have no large forests and yet we have plenty of water is the argument put forward, the Englishman being entirely oblivious of the fact that his little Island home is entirely surrounded by water! It is to his upbringing doubtless that the Englishman, both collectively and individually, takes so little interest in forestry and all appertaining thereto. In spite of the length of time the British have held sway over India, it is only now that the real importance of this question is beginning to receive that meed of recognition which has been accorded to it for a century and more, for even in the Middle Ages some attention was paid to this subject on the Continent

of Europe. Those who have followed forestry literature during the past decade are aware that slowly but surely a great awakening has been taking place all over the world and that opinions formerly cast-iron in their conservative ignorance have been modified and revolutionised. It may, we think, be said that this great reformation has found its real birth in India and America. Questions which affect numerically small nations and comparatively small areas of the surface of the globe have but a slight influence as world-wide factors in forming opinions held by the human race as a whole. When, however, populations and areas of the magnitude of those of India and the United States, let alone such great Colonies as Canada, Australia and Africa, are faced with similar problems, and problems involving the future well-being of the entire race, what was the common knowledge of the few becomes merged into the deep-rooted opinion of mankind at large. Such a state of affairs is rapidly becoming a *fait accompli* so far as the recognition of the importance of the forests on the water-supply of a country is concerned.

An article which deserves to be widely read entitled "Tree Influence on Rainfall" has, we note with pleasure, recently appeared in the columns of the Indian Press,* and we publish in this issue an interesting paper on the "Protection of the Sources of the Cauvery," in which some very noteworthy criticisms on the protection of the headwaters of the rivers in Madras appear.

Before proceeding to a consideration of some of the points raised in these articles, it may prove of interest here to quote the opinions on this subject of that eminent authority, Dr Schlich, as expressed in his "Manual of Forestry." We read that—

(1) Forests reduce the temperature of the air and soil to a moderate extent and render the climate more equable.

(2) They increase the relative humidity of the air and tend to reduce evaporation.

(3) They tend to increase the precipitation of moisture.

(4) They help to regulate the water-supply, produce a more sustained feeding of springs, tend to reduce violent

* Allahabad *Pioneer*, September 15th, 1900.

floods and render the flow of waters in rivers more continuous.

(5) They assist in preventing erosion, landslips, avalanches, the silting up of rivers and low lands, and arrest shifting sands.

(6) They reduce the velocity of air currents, protect adjoining fields against cold or dry winds and afford shelter to cattle, game and useful birds.

Many of our readers will be able to quote from their own personal experiences cases where the absence of or destruction of forest in this country has removed some of the benefits or given rise to some of the evils above enumerated.

Turning now to the article on "Tree Influence on Rainfall," the writer draws attention to the curious anomaly, which so well illustrates our opening remarks, that the Irrigation Commission which recently toured round the country entirely failed to take any cognisance of or to make any enquiries into the state of the catchment areas of the rivers upon which the whole foundation of their proposed elaborate network of canals entirely rested. We read—

This Commission travelled all over India, conferred with many authorities, visited works in the South, in the United Provinces, and in the Punjab, and then sat down and wrote what was meant to be an exhaustive report. They formulated proposals for new works or rather they re-stated authoritatively what had been proposed in former years, and on their recommendations colossal schemes of irrigation, costing millions sterling, have been approved and sanctioned by the Secretary of State. Yet in that Report (consisting of several hundred pages) the incidence that forests have on the question of irrigation at the present time and especially in the future, is a factor to which no reference whatsoever is made! This is a fact which German and French critics of this voluminous report cannot understand; as the intimate connection between rainfall, forests, and the discharge of rivers is a fact so early instilled in the minds of the educated on the Continent, that the omission of even a casual reference to the ultimate sources of water in a formal and in its way an epoch-making report, such as that presented to

Government by the late Irrigation Commission, is, to our foreign critics, inexplicable.

Possibly this otherwise unintelligible omission has an explanation. It may have been that an expression of opinion in this connection was ruled to be out of court for reasons of State, as a full exposition of the matter trenches upon somewhat delicate political ground. It may have been thought by the Commission that their mandate did not extend beyond the limits of British India. This is unfortunate, for as a matter of fact the territories between the 7,500 contour above the sea and the head works of our important irrigation systems in the north of India lie almost entirely in States beyond the administrative frontier of British India. Now it is between the level of the head works and about 7,500 that the intensity of the rainfall is at a maximum, that is to say, that the rain falling in that zone is chiefly, if not exclusively, responsible for the great floods that not only are wasted as far as irrigation is concerned, but that also are so destructive and cause such anxious moments to those in charge of the head works of our big canals.

If we take the excellent map of the Punjab published with the Punjab Administration Report for 1904-05, which exhibits quite sufficiently well the various canals and irrigation systems of that Province, as well as that of the North West of the United Provinces, we find that the effective catchment basins of the Upper Indus, of the Jhelum, of the Chenab, of the Ravi, of the Sutlej, of the Jumna, and of the Ganges are all in foreign territory. The effective rain and snow that tends to feed the flow of these rivers and the forests whose function in nature is to maintain this flow as a uniform and perpetual discharge, all occur in tracts over which the Government of India has not hitherto exercised its right of efficient control, the only exception being the Bias river, whose sources are in British territory. Consequently the rulers of these extra-territorial tracts are at liberty to cut down their forests, to hew down their trees, and allow reckless grazing without system or on any organised plan. To argue that this system can be continued with impunity or that our agricultural interests are not jeopardised by such reckless disboisment it shows a lamentable ignorance of the

most elementary principles of forestry. Surely it is not too early yet to bring influence to bear on the rulers of our Himalayan border and induce them to consent to their forests being administered on scientific principles.

That the evil of deforesting mountain ranges is a very real one, the well-known case of the Alps from France to Austria has proved once and for all. Wherever in these mountains extensive deforestation has taken place the consequence has been the gradual formation of a series of torrents in all places where the surface did not consist of hard rock; the débris brought down has covered more and more fertile land at the base of the torrents; and this evil has grown to such an extent that not only in France, but also in other Alpine countries, great efforts have been made to re-afforest the denuded area at a great outlay. When once the evil has been created, immediate afforestation is not possible; it must be preceded by the construction of dams, dykes, walls, etc., to steady the soil until the young forest growth has had time to establish itself and once more lay hold of the surface soil. It requires no detailed calculation to estimate the enormous cost such operations would entail in this country, nor the magnitude of the losses the covering up of the cultivated lands at the foot of the mountains would give rise to. The writer of the article alluded to above raises another aspect of the question, one which was alluded to in considering the position of the Cauvery river and the power required for the Kolar Goldfields. He says: –

Hitherto the rivers and canals have been regarded almost entirely from an agricultural point of view. If the rivers run low, or if the canals afforded an inadequate supply that was a matter that affected the ryot alone, and the disturbance to the canal revenue was a departmental incident whose occurrence did not affect other interests acutely. But will this be the case a generation hence? Will not other interests be concerned and will not other influences make themselves felt and demand imperatively a better regulation of the sources of their prosperity? A generation hence the value of hydraulic motive power along the whole southern aspect of the Himalayan Range from Gilgit to Assam and

thence south to Siam may have so increased, and its importance may have so appreciated, that any diminution of its effective force that can be possibly prevented will be resented by the whole power of industrial India, which a generation hence will certainly not be a negligible quantity. When new industries are set on foot, fresh demands are inevitably made on a Government. It has to undertake duties which before were not dreamt of; for instance, some twenty years ago that portion of France that is bounded on the north and west by the Rhone and on the east by the Alps and south by the Mediterranean was almost wholly given over to agriculture. Now it teems with industrial mills and factories, all actuated by hydro-motive power either directly or by means of electricity. Its area is about 22,000 square miles, or equivalent to the area comprised between Simla, Sirsa, Lyallpur and Jammu. Within this portion of France there were in 1904 no less than 46,000 hydraulic installations varying from 16 h.-p. to several thousand h.-p.

It will be unnecessary here to quote from our correspondent's letter on the "Protection of the Sources of the Cauvery" which will be found elsewhere; but attention may be drawn to the fact that the writer points out a state of affairs in the south which greatly resembles that existing in the Himalayan ranges to the north. In the interests of the community at large there can be no doubt that the time has arrived at which it has become of the very first urgency that the entire question of the available water-supply of the country should be enquired into by experts, and that an authoritative report on the catchment areas of all the important rivers, whether actually in British territory or in that of the great Native States, who are ever so ready to demonstrate their loyalty and allegiance to the Crown, should be drawn up. With this report before them the Government of India would be in a position to lay down definite rules upon the subject which would secure what may almost be termed the most important areas on the Continent from the destruction they have experienced in the past. This destruction has ever been in the interests of the few, either to satisfy a pecuniary greed or with the object of starting, in ignorance, experiments for

the cultivation of coffee, tea, or, as in the newly projected idea in Madras, of rubber on the catchment areas of rivers or far up on mountain slopes, the removal of the forest covering of which can but result, as in the case of the Alps, in heavy and lamentable denudation of the hillsides and the covering up of the cultivated lands below to the ruin of the unfortunate ryot.

In conclusion, we would suggest the formation of a small expert Commission consisting of an expert Irrigation Officer, a member of the Indian Civil Service who has had experience of the losses ryots have suffered from wanton destruction of hill forests, and a Forest Officer of experience. That this Commission should visit all the catchment areas of the important rivers of the country and submit a report on their present condition. That they should be also required to frame lists of all districts, no matter at what distance they might be away from the catchment areas of the rivers in question, which in their opinion depended on particular rivers for their water-supply. That in addition to reporting upon the matter from the agricultural point of view in the interest of the ryot, the Commission be asked to record, wherever possible, a note upon the possibility or otherwise of the rivers visited being serviceable as sources of hydraulic power.

SCIENTIFIC PAPERS.

ON POLLARD-SHOOTS, STOOL-SHOOTS AND ROOT-SUCKERS.

BY R. S. HOLE, F.C.H., F.E.S.

PART III.

In all cases hitherto considered neither pollarding nor coppicing can be regarded as a method of reproduction.

22. Hitherto in so far as we have considered pollard and stool-shoots, it is clear that we have been dealing with cases in which the individual tree, injured by the removal of its crown of branches, endeavours to repair the damage done and to regain its normal state of health. Under the most favourable circumstances then, all that we have here is a

more or less complete rejuvenation of the individual tree, there is no division of the parent plant with the establishment of new and independent individuals, and hence no true *reproduction* in the correct sense of the term.

23. The question next arises whether, under some circumstances, stool-shoots do become independent individuals provided with root systems of their own and not relying on the old roots of the parent tree, if so, we should be forced to conclude that true vegetative reproduction may take place not only by means of root-suckers but also by stool-shoots.

Authority for believing that vegetative reproduction may be effected by means of stool-shoots

The following authorities support the belief that such a supposition is at all events not impossible.

Dr. Schlich speaking of stool-shoots and root-suckers on p. 175, Vol. I, of his *Manual of Forestry*, says: "If the new individual is capable of producing root buds and of developing them into roots it becomes independent of the mother plant; in such a case reproduction is established by a division of the mother plant."

On p. 263 of Hartig's *Diseases of Trees (Eng. Trans. by Ward and Somerville)* we find the following remark on stool-shoots: "As it is very desirable that these should become self rooted, so that the new plants may be unaffected by the health of the parent stool it is an advantage to have them as low down on the stool as possible."

24. No one who has had experience of teak coppice forests can have failed to notice when an old tree, the interior of whose stem has entirely decayed, has been felled level with the ground, that vigorous coppice shoots often make their appearance from the periphery of the old stool, and that, after a few years, in the place of the stool which is no longer traceable on the surface, several young plants are found which, in shape and appearance, resemble healthy and vigorous seedling trees. Such shoots are often several feet apart, there is no visible connection between them at the ground surface and at the first glance we recognise that we have conditions here which differ widely from those

Stool-shoots of teak may produce independent roots

obtaining in the case of pollard-shoots, or of a group of coppice shoots situated on the top of a small and healthy stool. I have recently dug up several teak coppice stools and have had sections of them prepared. There is, I think, no room for doubt that with teak at all events coppice shoots are capable of developing independent roots of their own.

Probable that in the case of teak a division of the parent stool may occur with the establishment of independent individual plants, *i.e.*, that true vegetative reproduction is effected by means of stool-shoots

25. Whether or not the young shoots, in such a case, ever become entirely separated from the parent stool I have been unable to prove as yet. From the specimens seen by me, however, it does appear that in the case of teak coppicing, especially of old trees, usually results in the production of young shoots, many of which are provided with an independent root system of considerable extent, but which usually maintain alive in their immediate neighbourhood a more or less extensive area of tissue belonging to the parent tree. From this living tissue, which is situated below the level of the ground, adventitious roots are usually developed in considerable numbers which, it would seem, must help in procuring the necessary water and salts required by the young shoot nearest to them in return for the food materials supplied to them by that shoot. May we not then reasonably conclude that the living tissue which, before the cutting of the tree, was subservient to the dominating individuality of the parent stem, has, since the removal of the latter, become mainly devoted to the service of the individual shoot from which it receives the greater portion of its necessary food supplies; that, in other words, we have under such circumstances a more or less complete division of the living tissue of the mother plant with the establishment of distinct individuals?

It appears, it is true, possible that in many cases all the shoots arising from one stool, as above described are connected, more or less, directly with each other by links of living tissue, but there seems to be no *primâ facie* reason for believing that such connection between different individuals is in itself likely to be injurious, as already noted in paragraph 15 above

26. The question of decay spreading from the old stool to the young shoots, in the case of teak at all events, does not appear to be a serious danger. A young shoot 13 years old examined showed that the decay had only spread slowly downwards in the centre of the heartwood of one of the old roots of the parent stool in one case, whilst in others there was no sign of decay spreading to the young shoot or its roots.

Decay spreading to the young shoot is probably not a serious danger in the case of teak.

27. Such evidence may surely afford us reason to believe that with some of our Indian species continued reproduction is possible not only by root-suckers but also by means of stool-shoots.

28. The shape of the cut surface of the stool is a point on which much stress is often laid in the rules to be observed in coppice fellings and a dome-shaped surface is usually recommended, *i.e.*, one which is highest at the centre. It has been noticed, however, that a high stool may interfere with the development of the independent root system of a young shoot.

Best method of cutting the stool in coppice felling.

The rapid decay of the old stool thus appears not only to afford the necessary room for the development of such young roots but also to provide a soil enriched with decaying organic material from which they can obtain their needful supplies of salts.

In the class of cases mentioned in paragraphs 17 and 19 above, it has been pointed out that the object to be kept in view is the rapid recovery of the parent plant from the injury inflicted, the body of the parent plant being kept as far as possible *intact*, and this object would clearly be promoted by the rapid healing and covering over of the cut surface of the stem by healthy living tissue.

In the class of cases now under discussion, however, it would appear that the more extensive the independent root systems of the young shoots and the more rapid the decay and disappearance of the greater part of the stool and roots of the parent tree, the more successful are the young shoots likely to be from the point of view of reproduction. In other words, the object to be kept in view is not to maintain the body of the parent plant intact but to ensure its *rapid disintegration*.

29. It is doubtful whether we shall be able for several years yet to draw up sound rules for the management of our coppice forests based on an accurate knowledge of the life histories of our species, but on the evidence at present available, it would certainly seem preferable to adopt as a general rule for coppice fellings, a flat section cut level with the ground, and not a dome. The former offers no obstruction to the rapid covering of the cut surface by vigorous young shoots on a small stool, and, in the case of old stools, every extra bit of wood left in the stool may be distinctly injurious to the young shoots by obstructing the development of their roots.

In some cases, of course, where the decay is spreading from the old stool is likely to be injurious to the young shoots, or where natural decay is not likely to ensure the disappearance of the central portion of the stool with sufficient rapidity, it may be advisable to cut away the greater part of the stool, and, where the object is to favour the production of root suckers, the removal of the entire stool will often be necessary.

It is interesting to note that so long ago as October 1875, in a paper read at the Forest Conference held at Simla in that year, Mr. Fernandez recommended the following procedure for the coppicing of old teak :—

"The soil has to be dug up round the tree to be felled until the whole stem and principal roots are exposed. The stem should then be cut out as near as possible to its junction with those roots and the earth thrown back and gently pressed down."

It would obviously, however, in all cases be a question for decision whether the extra expenditure involved by such operations is justified by the improved condition of the resulting shoots.

Necessity for obtaining proofs regarding the characteristics of stool-shoots and root-suckers in the case of particular species and definite localities before accepting as true any general statement regarding them.

30. Sufficient has now, I think, been said to show that both root suckers and stool shoots may vary greatly in their character and with regard to the conditions under which they develop. Moreover, we know how greatly the same species may vary in different localities, and how much different species may vary in their behaviour where exposed to similar conditions and treatment,

in consequence of which we must recognise the necessity of not accepting any sweeping generalisation, such as "coppice shoots can never produce fertile seed" until we have obtained for ourselves proof that this is so with coppice shoots of the various types indicated in this paper, in the case of the particular species and locality we have to deal with. Mr. Fischer, for instance, has recently reported experiments on p. 198 of Vol. XXX of the *Indian Forester* from which it appears that seed obtained from sal coppice shoots was found to be fertile in Ganjam.

Advisability of commencing the systematic collection of data bearing on the points here alluded to without delay.

31. Seeing that such a large proportion of our Indian forests are now managed as coppice or as coppice with standards, the subject of the present paper appears to be one of great and daily increasing importance, and I have therefore ventured to draw attention to it now, when the establishment of a Forest Research Bureau with its complement of botanical and sylvicultural experts, being on the eve of becoming an accomplished fact,* encourages the hope that a commencement may now be made to systematically collect reliable data bearing on some of the points here mentioned, some of the most important problems perhaps being—

In the case of definite species, in selected localities :—

(*a*) Can true reproduction be effected by root-suckers or stool-shoots?

(*b*) What are the principal conditions which respectively favour and obstruct such reproduction?

(*c*) In each case which method of reproduction is the best?

(*d*) In what cases is pollarding preferable to coppicing?

(*e*) What are the best practical methods of felling to be adopted in each case with the object of helping the tree cut to recover from the injury inflicted as quickly and completely as possible?

It should be noted that the problems here referred to do not necessarily only concern those forests which are to be permanently

* Created on June 5th, *vide* R. and A. Department, Government of India, Forest Circular No. 11—166-2-F, dated Simla, 5th June 1906.

Photo.-Mechl. Dept., Thomason College, Roorkee.

TRANSPORT OF TIMBER BY HAND IN THE GOALPARA FORESTS.

managed as *coppice or coppice with standards. Their solution* will for instance enable us to decide whether, in some cases, a preliminary round of coppice fellings is not a better treatment to apply to a poor and irregular crop when it is desired to manage the same ultimately under one of the High Forest Systems than that usually known in India as the System of Improvement Fellings.

No apparent necessity for immediate anxiety regarding the possible denudation of our coppice forests.

32 In conclusion, it seems advisable to draw attention to the despairing strain so often found of recent years in our Annual Reports to the effect that our coppice forests are being denuded, as a good example of which we may take the following extract from the Bombay Northern Circle Report for 1894-95, printed at p. 457, Vol. XXX, of the *Indian Forester*: —

"It cannot be overlooked that there is a great dearth too often a total absence of seedlings to replace the present stools when their reproductive power shall be exhausted. The vitality of the present stools may last out two or even three revolutions, but unless seedlings are produced to replace them as they fail, the ultimate result must be denudation."

Seeing that there is reason to believe that both stool and pollard-shoots are not necessarily inferior to seedling trees in their power of producing fertile seed, and also that the continued reproduction of many of our species may be ensured by means of root-suckers or by stool-shoots, there certainly seems to be no ground for immediate anxiety regarding the possible denudation of our coppice forests.

ORIGINAL ARTICLES.

THE GOALPARA FOREST TRAMWAY.

BY W. F. PERREE, I.F.S.

PART I.

In places where ordinary means of transport are scarce or costly, where the use of carts is possible only for a *short season*, and where materials in quantity have to be transported in excess

of the capability of ordinary local means, tramways may often offer a solution of transport difficulties The Goalpara forests, which are situated under the Bhutan Himalayas at distances varying from 30 to 60 miles from the Brahmaputra river, have always suffered from insufficient means of export. The resident population has never kept draught cattle for any purpose beyond ploughing, and the transport of timber has been hitherto done by hand, large trees being cut into short logs (dhums) under 7 feet in length, which are rolled by hand som times for 12 or 15 miles to a floating stream. Smaller timber has been carried out of the forest on men's shoulders, *vide* Plate XXXIV. On reaching a suitable stream the timber is lashed to dugouts and taken to the Brahmaputra, whence it is rafted with the help of large boats to the principal towns of Eastern and Lower Bengal It is evident that these extensive forests could not be worked successfully by means of such primitive transport; the inaccessible blocks generally remained untouched and the entire yield was seldom brought to market. The land adjoining the reserved forests is, with the exception of a few Mech villages, almost uninhabited. Local labour is therefore scarce, while the unhealthiness of the Terai tract renders work by imported labour possible only during the short season from December to April. Difficulties are enhanced by the presence of a waterless or "Bhabar" tract, varying in width from 8 to 15 miles, which is waterless during the open season. Attempts to sink wells have been made, but below 30 feet large boulders are encountered rendering excavation next to impossible, and water is not found even at a depth of 80 feet. In deciding on additional means of transport, it was therefore necessary to always bear in mind that workmen in the "Bhabar" tract would have to be supplied with water. Elephants are in use for dragging timber and a part of the outturn has been extracted with their help, but these animals are liable to outbreaks of anthrax and are unsuited for work at a distance from water. Buffaloes or bullocks could have been used for draught, bu they would have involved the construction of roads for cart traffic which in forests where the rainfall exceeds 150 inches are soon churned into quagmires, and

the local cattle are infested with rinderpest and foot-and mouth disease, so there was clearly great danger in relying solely on horned cattle. After due consideration, it was decided to lay a tramway in the Western Range which is the most remote from the sale depôts and offers the greatest difficulties of transport as well as disadvantages regarding water-supply. The line was commenced from a convenient floating stream and gradually pushed northwards to deal with the coupes in succession. Some re arrangement of coupes was necessary to ensure the most economical use of the tramway. In 1901 02, a commencement was made with 2½ miles, subsequent additions bringing up the total to 9½ miles. The gauge and strength of materials had first to be settled. Portability is an important factor, and the universal 24 inch gauge was therefore adopted. In deciding on the strength of materials, it was necessary to know the safe loads for rails of different strength. The weight per yard of rails is used to indicate the quantity of metal in the various sections, so that the strength varies with the weight. The safe load is indicated by the maximum pressure which a wheel can carry without causing deflection in the rail, and this again varies with the spacing apart of the sleepers.

The following table shows the wheel pressures for different weights of rails with the spacing of sleepers in most general use :—

Sleepers apart.	Wheel pressures for rails of—					
	10 lbs per yard.	14 lbs. per yard.	18 lbs. per yard	18½ lbs. per yard.	20 lbs per yard	24 lbs. per yard.
40'	99[illegible]	1,700	1,960	2,485	2,900	3,970
36'	1,10[illegible]	1,900	2,130	2,755	3,210	4,600
32'	1 27[illegible]	2 150	2,500	3,170	3,685	5,300
27"	1,45[illegible]	2,510	2,900	3,650	4,230	6,075

These figures are approximate for mild steel and it should be remembered that laboratory tests require a substantial margin of

safety. The comparatively large differences between rails of 18 lbs. and 18¼ lbs. is due to the difference in section, the latter is nearly ½ inch taller and while offering greater resistance to vertical pressure is obviously more liable to lateral deflection. It is, however, important to realise that a comparatively light rail may carry the same load as a heavier one if more closely sleepered, a useful fact to remember in determining the initial outlay. In the present case it was considered that the maximum size of logs which the rails need carry would not exceed 50 cubic feet, allowing 70 lbs. per cubic foot and three such logs per bogie truck on eight wheels, the wheel pressure would be only 1,312 lbs., so that 14 lbs. rails would clearly be of sufficient strength, especially as the above maximum load would be very exceptionally carried. In order also to keep the initial expenditure as low as possible, 14 lbs. rails were decided upon, and, with a view to maintaining portability, corrugated steel sleepers weighing about 12 lbs. per yard and 40 inches apart were adopted. It has, however, been proved that on temporary lines where the sleepers do not always rest on a firm bed, it is preferable to place them at about 32 inches' interval. This admits of placing sleepers nearer the rail joints, at which places the rails always show a tendency to bend, especially on gradients where the speed of loaded trucks is considerable.

The rails are in 5 metre lengths (16½ feet); the materials were purchased in Calcutta from Messrs. Martin & Co., the then agents for Messrs. Arthur Koppel & Co.* I am greatly obliged to the latter firm for allowing me the use of woodcuts from their illustrated catalogue and for the table of wheel pressures above quoted.

The laying of the line offers no practical difficulty and is easily accomplished by unskilled labour. The ground in the tract here dealt with is generally level with a slight slope from north to south which is the general direction of the alignment. A few undulations and shallow depressions necessitated small embankments in order to keep the slope down to 1 in 200. After selecting the alignment, the trees are felled by the roots to a width of 10 feet, a track 6 feet wide is then raised about a foot above the

* Messrs. Arthur Koppel & Co. have now their offices at 1, Mission Row, Calcutta.

SECTION READY FOR LAYING TRAMWAY.

Photo.-Mechl. Dept., Thomason College, Rurkee. Photos, by W. F. Perree.

MATERIALS IN POSITION FOR SINKING.

PREPARING LINE FOR PACKING.

Photo.-Mech. Dept., Thomason College, Roorkee. Photos. by W. F. Perrée.

PACKING LINE.

surrounding level by cutting drains 2 feet wide on either side and throwing the earth on the centre. In high land this is sufficient, but in places liable to inundation the line must always be above flood level. The surface is then approximately levelled by eye—see Plate XXXII. The tramway materials are fixed together by a simple system of bolts and nuts. Mech and Santhal coolies were employed. It is important to keep a check on the issue of clips, bolts, nuts, etc.; such small articles are easily mislaid and lost. It is advisable to issue each morning the approximate quantity required for the day's work. The materials are roughly placed in position and bolted together—see Plate XXXII. The rails are fixed to the sleepers by clips which are bolted through the sleeper as shown in the annexed woodcut, Figure 1. There is a rectangular hole in the

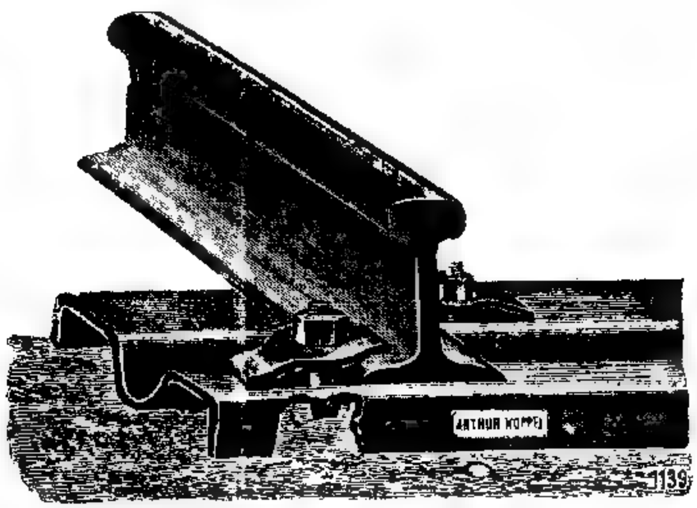

FIG. 1.—CLIP AND BOLT FASTENING FOR ATTACHING RAILS TO SLEEPERS.

sleeper through which the similarly shaped bolt head is passed. The bolt is then turned through 90° and the clip firmly screwed down. The holding is found to remain firm for years. In the last extension of 3½ miles, which it is calculated will remain in position for 6 or 7 years, wooden sleepers (4½′ × 5″ × 4″) at 33 inches interval have been employed. The cost is very little less per mile than if

steel sleepers at 40 inches interval are used, owing to the enhanced cost of laying by skilled labour.

The defect in the steel sleeper is that, resting on the surface and the end being open, it does not offer the same resistance to lateral displacement as a wooden sleeper firmly buried to a depth of 4 inches in the well trodden earth. Wild elephants walking between the rails kick them outwards as they pass along and displace the line laid on steel sleepers laterally but have no such effect on the section laid over wooden sleepers. After the line has been securely bolted it is straightened with crowbars and packed. For this purpose some earth is thrown on the line from the drains and packed firmly under the sleepers (see Plate XXXIII). This is an important operation as the line must at the same time be finally levelled, and the firmness of the rails as well as the durability of the line depends on this. Ballasting is unnecessary but good drainage is essential. Men should patrol as soon as possible after rain and open all drains which may be choked and let out any water which may collect between the rails. Plate XXXI shows a finished section of line.

For control of traffic and also in order to facilitate laying, long straight lengths are preferable to a series of curves, however slight. The laying of curves is a simple matter. As a rule this can be done by eye, remembering always that too steep a curve is apt to cause trucks to derail; on the other hand, it is not advisable to bend more rails than are absolutely necessary, as this may affect the usefulness of materials later on. A jim crow (see Figure 2) is applied at intervals of a foot or so along the rail until it reaches the necessary curve. Some practice is required to apply force evenly all along the rail and thereby avoid an uneven curve. Having completed one rail, the other is placed on top of it now and then, as the jim crow is applied, in order to gauge the progress and thereby ensure exact correspondence of adjoining rails. When lifting the line and relaying it in another place, it is not necessary to open the sleeper bolts at all, the fish plates only need be opened and the line lifted in rail sections. In practice it is found easy to lift the 14 lb. plant in sections of two rail lengths.

For this purpose the rail joints should be kept exactly opposite each other. This is not possible on curves, where the inner rail soon projects beyond the outer. The former can be cut or on temporary lines a block of wood may be inserted to fill up the gap.

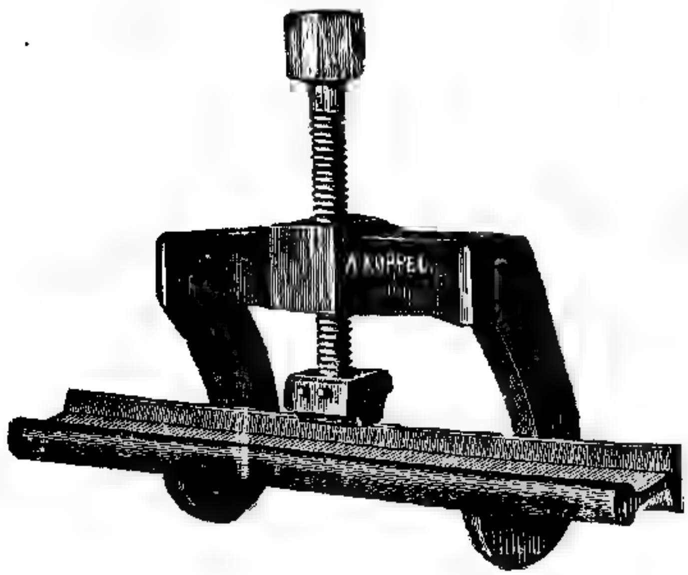

FIG. 2.—"JIM CROW" OR RAIL BENDER.

If hard wood is employed and firmly fixed to a wooden sleeper renewal will not be necessary more often than twice a year.

Rolling stock, the outlay and working of the tramway will be dealt with in a subsequent article.

THE PROTECTION OF THE SOURCES OF THE CAUVERY.

In the May number of the *Indian Forester* appears a short article entitled "Mysore Forests and the Cauvery River," calling attention to the necessity for the careful preservation of the forests on the catchment area of the Cauvery. Judging from the various articles which have been printed in the *Indian Forester*, any stick is good enough to beat Mysore; but is Mysore alone to blame

for want of protection of these important areas? The answer must surely be in the negative. Every tree that grows must, of course, have its effect on the distribution of water, but though I have never seen this principle clearly laid down, I think it is generally accepted that from the water point of view the deciduous forests represent the copper, the semi shola the silver and the true shola forests the gold. If this axiom be true, it is the protection of the actual evergreen forest which is of the first importance, when the proper distribution of water is considered. As far as my experience goes in the south of India, no reckless destruction of Government shola forest is going on for the sake of the revenue from timber. The most valuable trees in this class of forest are the Mesua ferrea, the Ebonies, the Gluta Travancorica of Tinnevelly the White and Red Cedars of the West Coast and the Poonspar and Artocarpus hirsuta of the Anaimalais and the West Coast. Valuable as are these species, their distance from the various centres of consumption renders them less remunerative than the more easily extracted Teak, Vengai and Rosewood. There is then little danger from over extraction of timber, but, in other ways, much of this valuable forest has been or is being destroyed, and an examination of the Cauvery river cannot but be instructive from several points of view. Not only is Mysore benefited by the supply of water in the Cauvery but a great deal of the wet cultivation of Coimbatore, Trichinopoly and Tanjore is dependent on it, and the value of a regular supply of water can therefore scarcely be over-estimated.

My geography is distinctly weak and I am quite open to correction, but are not the actual sources of the Cauvery outside Mysore and somewhere up in the Western Ghats of the Bombay Presidency*? If this is the case, then Mysore is not able to control the chief source of supply, and can only assist in its maintenance by the proper upkeep of the shola forests of the principal streams which fall into it. At all events Mysore is not in any way responsible for the proper supply of water in the Kabbani, a large river which falls into the Cauvery before it reaches the Sivasamudram

* The Cauvery river rises in the Western Ghats in Coorg.—[Hon. Ed.]

works, and which alone should, if properly controlled, give sufficient water for the continual supply required by those works. Now the Kabbani is a Mysore river and belongs to Mysore alone, but Mysore has practically no control over it whatever. Throughout its course it runs through dry arid plains, with no forest near it but the dry deciduous forest round Kakenkotta and the neighbourhood. But the Kabbani itself is formed by three considerable Malabar rivers, known locally as the Pannamaram, the Manantoddy and the Bavali rivers. All these rise in the dense sholas of Malabar and run through the Wynaad, a country which should be dense with evergreen and semi-evergreen forest. As regards the sources of the Pannamaram I know very little; but it rises in the region of heavy rainfall and runs through a country, which must at one time have been dense shola which, however, was subsequently converted into coffee estates. When these estates were abandoned, the original sholas became a dense mass of lantana or bare grass land, the remaining forest being subjected to that pernicious system of cultivation known in various districts as Tuckle, Ponam, Podu, Kumri, and a variety of other names. The Manantoddy river is formed by three considerable streams which rise in dense sholas, but to my certain knowledge a large part of the catchment area of the chief of these has been cleared for coffee and abandoned, and the shola which contains the headwaters is now to be opened out for the sake of an experiment in rubber. Now it may be argued that Government has nothing to do with these lands, because, as is usually the case in Malabar, the lands belong to private owners; but considering the vast interests at stake both in Mysore and in British territory, ought not the Government to step in and acquire the catchment areas of these streams and rivers and insist on their rigid protection? The Bavali rises in what is now Government evergreen forest and runs for a great part of its length through semi-shola at the bottom of a deep valley, which forms a splendid catchment basin. Unfortunately, however, considerable areas in the valley were at one time given over to coffee estates but under protection these are gradually reclothing themselves with forest and it is the duty of the department to see

that this forest is properly protected and so contributes its proper share towards the perennial water-supply of the Cauvery.

The next portion of the Cauvery to be considered is that between the Sivasamudram Falls and the Bhavani. In this portion there are no large rivers, but there are three considerable streams which ought to add considerably to the water-supply. These are the Gundila, the Odonthara Halla and the Palar. Most of the water of the Gundila drains into a series of large tanks near Kollegal, where it is absorbed by wet cultivation, but the balance drains into the Cauvery, and all the drainage from the Kollegal fields must also eventually find its way to that river. This stream is dependent on the dense sholas around Bellagie, the chief of which is the fine Bellagie shola itself. It is therefore surprising to learn that part of this splendid shola is to be given up to the rubber craze. Apart from this the fire protection is not what it ought to be in this neighbourhood, and, what with the mischievous sholagar and the incendiarist shepherd there is little doubt that the shola forest, instead of increasing in area, is little by little being eaten into by fire. The Odonthara halla rises from the same neighbourhood and has been chiefly mentioned to call attention to the fact, noted by Mr. A. W. Lushington, that within the memory of man it was a perennial stream but is so no longer, clearly proving that our protection of the sholas is not what it ought to be. As regards the Palar, I can say very little, for though I have often been along its banks, I have never traced it to its source, which is, I believe, in a somewhat inaccessible portion of the Burgur Hills. Its very inaccessibility may have assisted in the protection of the head-waters, but as all that part of the country is a vast grazing ground, I consider it very possible that the protective forests are being lessened by fire, which, in North Coimbatore, appears to be the natural concomitant of grazing.

The next important tributary of the Cauvery is the Bhavani, with its perennial affluent, the Moyar. Of what importance this river is may be judged by the fact that for many years there has been a project under investigation of bunding up these two rivers with a big dam, thereby forming a large lake of about 40 square miles.

The chief object of this scheme is to lead the water into the Cauvery during the dry weather and thus secure the third crop of paddy in the Tanjore District.

The Moyar is very nearly as important as the Bhavani itself, for, though it is only a small river, yet in the hot weather it is always full of water, and from this I should judge that its sources are well protected. These sources are, I believe, in the Nilgiri District in the Moyar reserve, but on this point I am not certain, and it is for the District Forest Officer of that Division to say to what extent they are protected.

For the greater part of its length this river runs through forest reserve and, after entering North Coimbatore, it receives useful additions from the reserve known as the Nilgiri Eastern Slopes. Even their protection is by no means perfect, as parts are occupied by coffee totes, and the T[illegible]lars are a source of nuisance breaking up out-of-the way parts of forest for cultivation and setting fire to the slopes. As, however, the reserved area is large and the portions cultivated small, the sources of water cannot be greatly affected.

The Bhavani river itself rises in the Attapadi valley in South Malabar, and in this valley Government have been able to secure some small patches of reserve, but the greater portion has been declared to be private land, and disputes as to ownership have been innumerable and have actually given rise to bloodshed. Many years ago Mr. Porter was instructed to report on the forests required for the protection of the headwaters of this important river, and he seems to have made some judicious selections which, however, were not acted upon, possibly because Government were not prepared at the time to acquire such a large extent of private forest. Needless to say these private forests have since deteriorated under the woodcutter's axe and the Ponam of the hillman, but there are still large areas practically untouched, owing to their inaccessibility, and it would be well for Government to acquire them before they are destroyed, and to carefully protect them when they are acquired. This will mean the proper opening out of the valley and the spending of money on rest-houses without much hope of return from the forest point of view, but the return

will be there in the increased and properly regulated supply of water, not to Malabar, but to the Tanjore District, many miles away. What then are the lessons to be learned from this study of the Cauvery system?

(1) That we should not throw stones at Mysore, until we have thoroughly protected our own glass houses.*

(2) That we should point out to Government that it would be wise to spend money on the protection of water sources without any hope of direct return.

(3) That our shola forests must be treated with the greatest caution and that we must look upon them as protective and not remunerative.

(4) That the hillman is out of place in a shola forest, and that if he will not conform to the uses of civilisation he will have to go elsewhere for the sake of the welfare of the greater number.

(5) That we must steel our hearts against the wiles of the planter so long as the land he requires is in the vicinity of an important source of water (which it generally is).

(6) That we should insist on the proper protection of sholas which are now in our possession, and spend money in fire protecting them without hope of direct return.

Government spends large sums of money in the investigation of possible irrigation projects. Is it too much to ask that they should properly investigate their natural sources of water and see that they are being protected in the right way?

P. M. LUSHINGTON.

CAMP ANTERASAUTA:
9th July 1906.

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* The *raison d'être* of the *Indian Forester* is to draw attention to and impartially discuss any and every point bearing upon forest matters, amongst the most important of which is the subject here treated of. Our correspondent will therefore, we feel sure, admit that the writer of the note on the 'Mysore Forests and the Cauvery River,' who has no connection with either Mysore or Madras, has performed a service of no mean value; for his remarks and inferences with respect to the state of things in Mysore have resulted in our correspondent's most interesting and valuable note on the position of affairs in Madras. [HON. ED.]

Photo. Mech. Dept., Thomason College, Roorkee. Photo. by R. N. Mukerji.

LOGS LOADED ON BOGIE,

INDIAN FORESTER

OCTOBER, 1906.

RECRUITMENT FOR THE INDIAN FOREST SERVICE.

In a leader written last year on the subject of the future training of the controlling staff of the Indian Forest Service, we described the new qualifying examination for the admission of probationers to the Department introduced at the time of the transfer of the Forestry College from Cooper's Hill to Oxford. It will be unnecessary to recapitulate details. The subjects, although the standard was a childishly low one, were Mechanics and Physics, Chemistry, Zoology and Botany—a good selection. Unfortunately neither the small amount of knowledge required by the examination, the course of instruction to be followed subsequently by the successful competitor nor the prospects offered him in the Forest Service, appealed to the University undergraduate, and the effort to obtain probationers in this way proved a failure. There were several reasons attributable for this non-success: the recent transfer of the College to Oxford, inadequate knowledge on the part of the public at Home as to the nature of the Department or what forestry meant, etc. Towards the close of the year therefore a fresh attempt was made to secure candidates for the present

year. A circular was issued from which we published extracts last February. In this paper not less than ten appointments were offered to be competed for at an examination to be held in London by the Civil Service Commissioners on August 28th, 1906. The age limit was fixed between 18 and 21 years and an alteration was made in the entrance examination by the omission of Zoology—only the elements of the other three subjects being demanded; the qualifying examination in German was still, however, insisted upon. What was the result? Candidates still failed to come forward, and this certainly through no fear of the difficulties of the examination test: for an averagely sharp boy of fifteen on the Science side of a public school could have faced it with composure. As a consequence we have read recently in the English daily press a circular, issued by the Secretary of State for India and dated August 16th, 1906, in which the following amazing offer appears:—

1. The Secretary of State for India in Council gives notice that he is prepared to receive applications for appointment, otherwise than by examination, of probationers for the Indian Forest Service. In choosing candidates he will be guided by a Selection Committee.
2. Candidates must be between 18 and 21, but the Selection Committee will be empowered to recommend the relaxation of the higher limit in any case in which they may think fit.
3. Candidates will be required to have a knowledge (*amount not stated) of Chemistry, Physics and Mechanics. A knowledge of Botany and German will not be insisted upon.*

We cannot but feel that we are expressing the opinion of the Service when we say that it stands aghast at the above advertisement. No qualifying examination and therefore recruitment from the ranks of the brainless men who were at the bottom of the forms at public schools; no age limit and therefore all the failures who have tried for the Army, Police and every other examination possible and have been plucked for deficient education or, worse still, lack of brains. No knowledge of Botany the foundation of

the future work of the Forester. No knowledge of German insisted upon and yet the candidate has to spend a year at work in Germany, work the successful assimilation of which depends entirely on a thorough colloquial knowledge of the language. To acquire such, many valuable hours during the two years course at Oxford will have to be devoted to tuition in a subject in which the probationer should have been educated during boyhood. How can such men be expected to carry on the work of a progressive department, built up by men who entered it by competition and in whose ranks have been found men who have proved themselves to occupy, intellectually, a high plane.

We would wish it to be understood that our criticisms on the circular and on the present position of affairs are made entirely in the interests of the Service and the Government whom that Service will endeavour, with many disadvantages to contend with, to serve as devotedly in the future, we feel we can confidently state, as it has served it loyally in the past. We deprecate any other interpretation being read into this attempt to review the present position. In the remarks which follow we trust to be able to aid in the solution of a difficult problem, not to strew stumbling blocks in an already arduous path.*

In weighing the present position of affairs we would first put for consideration the following point: Why, we would ask, was it possible, with the far more expensive education at Cooper's Hill (for the three years' tuition cost the student £1,000) to obtain candidates to sit at the examination year after year in sufficient numbers to ensure a selection; though this selection fell off considerably, as all are aware, from the date of the amalgamation of the Forest and Police examinations? We consider the answer is to be sought in one direction only. It is but recently that the British public have really understood what the Forest Department in India really is, and this knowledge owes, we think, its origin to the publicity given to the closure of Cooper's Hill, the transfer of the Forest probationers to Oxford and the struggle which took

* In this connection we would invite attention to the article which appeared on this subject in the *Indian Forester*, Vol. XX, pp. 10-12.

place between Oxford and Cambridge before the new course was established at the former University. The course is cheaper now than in the old days, but public attention having been drawn to the matter, the emoluments and prospects of the Department have been found so little attractive, when the long and unavoidably expensive course of tuition the profession of a Forester necessarily entails (and upon the necessity of such a course we are all agreed) is taken into account, that the fiat has gone forth that the Service must for the present be tabooed.

Now this is a most serious position of affairs and one which we are fully aware has been receiving the earnest consideration of all those responsible for the management of the Department in India. Dr Schlich has, in a recent letter, pointed out that the Department cannot expect to get really good men under present conditions of pay and service, and we fully endorse an opinion coming from such an eminent authority. A careful consideration of the matter would seem to leave but two courses open if the Department is to be maintained at a high level. Our suggestions are as follows: first improve the prospects of the Service in India and then stiffen up, and stiffen up very considerably, the entrance examination at Home.

We believe the Department would be content, and we have little doubt that if the Service in India is content candidates will soon be forthcoming at Home, if the Secretary of State would reorganise it on the following generous lines: -

1. If he would be disposed to reconsider the terms lately *granted to Conservators, accepting in lieu those proposed* by the Government of India to Local Governments in their circular of last year.
2. Accept the terms that may be proposed by the Government of India for increasing the emoluments of Deputy Conservators and Assistant Conservators.
3. Grant the extra pension of Rs. 1,000 to all Conservators.
4. Cancel the petty but obnoxious restriction that Conservators are not allowed to officiate in a higher grade in privilege leave vacancies.

We would venture to hope that the above suggestions will be received in the spirit in which they are written—the one aim being the improvement of the conditions of service in order to ensure high efficiency; for on this alone depends future effective administration and increased economic and financial possibilities.

Our second point is the stiffening up of the entrance examination. It is beyond dispute that the stiffer an examination is made, of course within certain limits, the greater the fascination it is likely to have for the majority of candidates; and, *ipse facto*, the higher the value they will attach to the Department to gain admission into which it has been prescribed. An easy entrance examination is *not* an advantage to any Department.

The Army has often been looked at askance by good men owing to the relaxation of the competitive tests and to the many other backdoor ways of entering it. We cannot but think that the lowering of the standard of the Forest entrance examination in the past has perhaps been regrettable. With improved prospects in the Department itself, we would strongly recommend this standard being so raised as to attract first class men. On the assurance of the supply of such the future of the Department depends—a future which is, at present, trembling in the balance.

SCIENTIFIC PAPERS.

SHRUBS AND TREES OF THE EVERGREEN SHOLAS OF NORTH COIMBATORE.

BY C. E. C. FISCHER, I.F.S.

The main mass of the forests of the North Coimbatore Division are deciduous and generally very dry. On the higher hills, however, patches of evergreen forests are met with surrounded by large areas of grass lands. Such forests known as "sholas" are met with principally on the north-western boundary adjoining the Mysore Province along the ridges of the Billigiri Rangan hills. There are, however, three or four detached ones further east, and

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one in the easternmost reserve on the Palamalai hills overlooking the Kaveri river which here divides the Coimbatore and Salem districts. At one point a small section of the Nilgiri hills with two small sholas is included. These sholas are found at elevations above 4,000 feet and usually over 5,000 feet. The highest point in the Division is Kattari Leetta in the Biligiri Rangans which is 5,973 feet.

There is some difference of opinion as to what area was formerly covered by shola in these localities. Did they once cover all the hills about 4,500 feet where now tall grasses practically monopolise the soil? The local sholagas deny this and say that the evergreen forest never extended beyond its present limits. There is, however, ample evidence that they are wrong, detached bits of shola appearing here and there at short distances from larger ones, which are no doubt vestiges of former continuous tracts of evergreen. There seems no reason why wherever there is sufficient depth of soil there shola should not grow. Constant firing has, it is certain, considerably diminished the area of evergreen forest. Fires usually do not run through a shola, but gradually wear away the edges, the dense high grass of course facilitating the process. Occasionally a natural protection in the shape of a dense protective belt of a stout shrubby species of strobilanthes is found along the margin. Once shola has been replaced by grass, its re-establishment must be a lengthy and difficult matter. Where, however, grass has not occupied the soil cleared of evergreen (as in clearings for cultivation subsequently abandoned), the latter frequently springs up again from seed or from the pollarded stumps. The sholas may be said roughly to be of two kinds, which may be termed "wet" and "dry" sholas respectively, and are characterised by the presence or absence of Calamus Rotang which is found in wet sholas only. The sholas have been comparatively little explored and their components are not generally known. They are somewhat inaccessible, and, further, the number of useful kinds of timber trees is small, the trees being mostly soft wooded, so that they have received little notice from foresters except as a protection for water sources. With the small material available,

it is too early yet to make a botanical survey of this flora, but enough is known to trace its affinity with the flora of the Malabar Province or India Aquosa (Prain's Bengal Plants) and to show that it is an eastern incursion of that province.

The appended list is of course anything but complete, but as no list is available for reference, I have ventured to prepare a preliminary one as a commencement and it can be amplified later.

The sholas occur on all aspects, the largest and also the best representative of the "wet sholas" occupying the head of a fine perennial stream running almost due north. This fine patch of some 3,000 or 4,000 acres is very densely stocked. A recent valuation gave 240 trees over one foot in girth per acre, many stems being from 8 to 12 feet. Mr. Talbot's description of the "Kans" in Kanara in a recent issue of the *Indian Forester* would fit this area equally well.

The vernacular names quoted, unless otherwise stated, are those used by the local hill men, sholagas, who speak a Kanarese dialect. The species marked with an asterisk are those quoted by Mr. Talbot as appearing in the North Kanara Kans :—

Anonaceae.

1. Goniothalamus Wightii. H. f and T.: flowers March ; small tree
2. Miliusa indica. Leschen : flowers from June to December ; small tree.

Menispermaceae.

3. Cocculus laurifolius. D. C. flowers March, fruit : October ; small tree.

Bixaceae.

4. Scolopia crenata Clos.: flowers June ; a tree not confined to sholas. Tamil *Chekkata.*

Polygalaceae.

5 Polygala arillata Hamilt.: a shrub with bright yellow flowers.

Sterculiaceae.

6. * Sterculia guttata. Roxb *Mata* : fruit March , a tree.

Tiliaceae.

7. * Elæocarpus serratus. L. flowers and fruit August and September, a tree.
8. * Elæocarpus tuberculatus. Roxb. *Kumai.* flowers March; a large tree.

Rutaceae.

9. Toddalia aculeata. Pers: a scandent prickly shrub, only in dry sholas and not confined to evergreen forest; flowers during rains.
10. Murraya Konigii. Spring: flowers May, fruit September; a shrub.
11. * Atalantia racemosa. W. and A., flowers May, a shrub.
12. Atalantia ceylanica. Oliv.: flowers May and June; a shrub.

Meliaceae.

13. Cedrela microcarpa. C. DC: flowers March, fruit June; a very large tree producing valuable timber.

Olacaceae.

14. * Mappia fœtida. Miers. *Moragadi*: a tree usually small; flowers April and May, fruit May and June; the flowers have a putrid smell which has called forth the name of "dead dog tree" in the Nilgiris.

Celastraceae

15. * Salacia oblonga. Wall.; flowers April; a shrub.

Rhamnaceæ.

16. Rhamnus dahuricus. Pall. flo. Ross; shrub in dry sholas, flowers May.

Sabiaceae.

17. Meliosma Wightii. Planch. *Meorai*: a tree; flowers July to December.
18. Meliosma Arnottiana. W. *Mushitaka*: a tree; flowers May.

Leguminoseae.

19. Acrocarpus fraxinifolius. W., flowers February, fruit June; a large tree.
20. Albizzia stipulata. Boiv. flowers April; a large tree.

Rosaceae.

21. Rubus moluccanus. Linn	Thorny scandent shrubs at the edges of sholas and in clearings.
22. Rubus ellipticus. Smith	
23 Rubus lasiocarpus. Smith *Ollakuananu.*	

Myrtaceae.

24. Eugenia spicata Laurk : a small tree; flowers April.
25. Eugenia Gardneri Thwaites : a small tree; flowers March.

Araliaceae.

26. Heptapleurum racemosum Bedd.: a tree; flowers June.

Caprifoliaceae.

27 Viburnum punctatum. Ham.	Small trees, not confined to shola
28. Viburnum coriaceum. Blum.	

Rubiaceae.

29. Plectronia Wightii. I. Cooke. *Ambai* : a small tree.
30. Ixora elongata Heyne : flowers March to May, a shrub.
31. Psychotria truncata. Wall.: flowers March to May; a shrub.
32. Psychotria elongata. Wight : flowers March; a shrub.
33. Lasianthus ciliatus Wight : flowers May and June; a shrub :

Compositaceae.

34. Vernonia arborea. Ham. *Kanakarugulu* : a tree usually small

Myrsinaceae.

35. Mæsa indica. Wall : flowering and fruiting most of the year Small shrub in dry sholas and not confined to sholas.
36 Embelia Ribes. Burm : flowers April: scandent shrub.
37. Ardisia pauciflora. Heyne : flowers May ; shrub.
38. Ardisia solanacea Roxb. (A humilis, Vhl.) : flowers May to September; shrub.

Sapotaceae.

39. Sideroxylon tomentosum. Roxb. *Kappali* : flowers May; a large tree

40. Isonandra Candolleana. Wight. *Thirigalla*: flowers May; a shrub or small tree.

Styraceae.

41. Symplocos spicata. Roxb. *Manasigga*: flowers rains, fruit May; a small tree.

Oleaceae.

42. Olea glandulifera. Wall. *Naruvelu*: flowers May; a large tree.

43. * Olea dioica. Roxb. *Kundai*: flowers March; not confined to sholas; a tree

44. Ligustrum robustum. Blume. *Gandunevavilleau*: flowers May, on the edges of sholas and in grass land; a small tree.

Loganiaceae.

45. Fagræa obovata. Wall. *Agina*: flowers May; a large tree with large handsome white fleshy flowers

Solanaceae.

46. Solanum giganteum. Jacq.: flowers March to June, fruit August; an unbranched thorny shrub.

47. Solanum ferox. Linn.: a thorny shrub.

Acanthaceae.

48. * Strobilanthes barbatus. Nees } Small shrubs which
49. Strobilanthes luridus. Wight. } spring up rapidly wherever light penetrates through the canopy and forming dense thickets.

Verbenaceae.

50. * Callicarpa lanata. Linn. *Karavelu*: flowers May to September; not confined to sholas; a small tree.

Laurineae.

51. Cinnamomum Perrottetii. Meissn.: flowers March, a small tree.

52. Machilus macrantha. Nees. *Karavedi*: flowers March, fruit April; a fair sized tree not confined to sholas.

53. Alseodaphne semicarpifolia. Nees: flowers December to March, a middle-sized tree.

54. Litsaea tomentosa. Heyne. *Massaipavatai* : flowers June to December ; a small tree not confined to sholas

55. * Litsaea zeylanica. Nees : flowers June to November ; a shrub or small tree not confined to sholas

Elaeagnaceae.

56. Elaeagnus latifolia. Linn. Tamil *Pulau* : flowers nearly throughout the year ; a shrub often scandent, readily recognisable by the silvery scales on leaves, flowers and fruit ; not confined to sholas.

Euphorbiaceae.

57. Phyllanthus longipes Muell. Arg.: flowers March, fruit August ; a shrub.

58 Glochidion neilgherrense. Wight : flowers March ; a small tree.

59. Bischofia Javanica. Blume. *Nirallu* : flowers March ; a small tree not confined to sholas.

60. Croton aromaticus. Linn.: flowers and fruit March ; a small tree.

61. Mallotus walkeræ. Hook. f.: flowers May ; a medium-sized tree.

62. Mallotus barbatus. Muell. Arg. *Heraku* : flowers May and June ; a fair sized tree.

Urticaceae.

63. Ficus glomerata. Roxb. *Atti* : a fair sized tree.

64. Artocarpus integrifolia. Linn. *Alasa* : flowers January, fruit May and June ; a large tree.

65. * Debregeasia velutina. Gaud.: flowers January, fruit March ; a small tree.

Palmaceae.

66 * Caryota urens. Linn. not common ; a tree.

67. Calamus Rotang. *Betta* : flowers March, fruit August ; a scandent, very thorny shrub forming dense thicket in the wet sholas only.

Graminacae.

68. * Oxytenanthera Thwaitesii. Munro : a shrubby slender semi-scandent bamboo.

Filices.

69. Alsophila latebrosa. Hook.: a shrubby tree-fern along streams in wet sholas.

These notes are penned from a forester's point of view, and so I have not included herbs and ferns in the list. In order, however, to enable comparison to a certain extent with the Malabar flora the number of species so far identified in each natural order (including trees, shrubs and herbs) are tabulated below.

1. Ranunculaceæ	..	2	25. Styraceæ	..	1
2. Anonaceæ	..	2	26. Oleaceæ	...	4
3. Menispermaceæ	..	1	27. Asclepiadaceæ	..	1
4. *Bixaceæ*	...	*1*	28. *Loganiaceæ*	...	*2*
5. Polygalaceæ	..	1	29. Solanaceæ	..	3
6. Sterculiaceæ	..	1	30. Gesneraceæ	..	1
7. Tiliaceæ	..	2	31. Acanthaceæ	..	5
8. Rutaceæ	..	5	32. Verbenaceæ	...	1
9. Meliaceæ	..	1	33. Labiateæ	...	3
10. Olacaceæ	..	1	34. Piperaceæ	...	6
11. Celastraceæ	..	1	35. Lauraceæ	...	5
12. Rhamnaceæ	..	1	36. Elæagnaceæ	...	1
13. Vitaseæ	...	1	37. Loranthaceæ	..	1
14. Sabiaceæ	..	2	38. Euphorbiaceæ	...	7
15. Leguminoseæ	..	3	39. Urticaceæ	...	7
16. Rosaceæ	..	4	40. Orchidaceæ	..	6
17. Myrtaceæ	..	3	41. Scitaminaceæ	..	1
Cucurbitaceæ	..	1	42. Haemodoraceæ	...	1
18. Begoniaceæ	..	1	43. Dioscoriaceæ	...	1
19. Araliaceæ	..	1	44. Liliaceæ	...	2
20. Caprifoliaceæ	..	2	45. Palmaceæ	...	2
21. Rubiaceæ	..	6	46. Aroideæ	...	3
22. Compositaceæ	..	4	47. Graminaceæ	...	1
23. Myrsinaceæ	..	4	48. Filices	..	26
24. Sapotaceæ		2			
			Total	...	144

COIMBATORE :

14th August 1906.

Photo.-Mechl. Dept., Thomason College Roorkee. Photo. by W. F. Perrée.

WATER TANKS.

ORIGINAL ARTICLES.

THE GOALPARA FOREST TRAMWAY.

BY W. F. PERRÉE, I.F.S.

PART II

In purchasing rolling stock it was necessary to arrange for trucks which would be suitable for use as bogies for long timber or singly for the transport of short logs and sleepers. It was therefore decided to purchase iron trucks with a removeable bolster. Figure 3 illustrates this type.

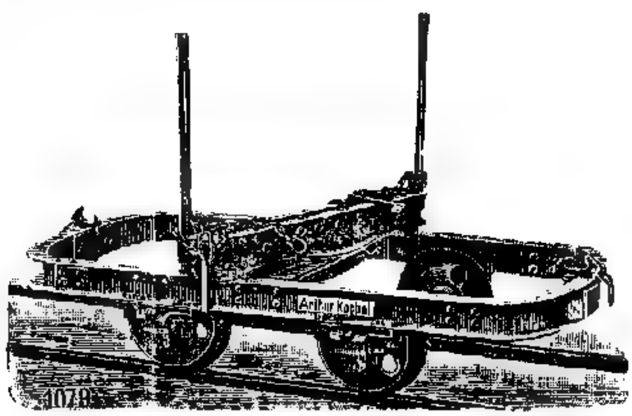

FIG. 3. TRUCK FITTED WITH REVOLVING STEEL BOLSTER AND *CHAINS AND HOOKS, FOR THE CARRIAGE OF LONG TIMBER.*—Usually *made for* loads of from 1½ tons to 3 tons per bogie.

The frames are 6 ft. in length and 2 ft. 10 inches in width, outside measurements. The upper surface of the frame is 1 foot above the top of the rail and the distance between centres of the wheels is 2 ft. The axle-boxes are of cast iron and the bearings are of white antifriction metal. There is great economy in oil and traction by the use of closed axle boxes with white metal bearings.

The latter have been found to last over five years and can be renewed at a cost of one rupee apiece.

Recently an experiment has been made in introducing roller-bearings, a modification of the well-known ball-bearings, on the trucks used to carry water, the frames of which were made locally. Figures 4 and 5 illustrate the axle-box mounted and unmounted.

FIG. 4. AXLE-BOX—MOUNTED.

FIG. 5.—AXLE BOX UNMOUNTED.

The makers claim a saving in traction of up to 50 per cent by their use, and although this statement has not been tested, the saving in traction is very marked. Plate XXXVI illustrates the locally made trucks fitted with roller-bearings in use for the carriage of water. Each truck carries [illegible]8 c.ft of water 31 cwt. Three men easily propel this load and make two trips daily, or a total journey of 22 to 24 miles. Of course on the return journey when the gradient is mainly with the load, the trucks run two thirds of the way without assistance. The same work could not, however, be accomplished with ordinary bearings.

It was thought at first that brakes would be necessary, and half the trucks were provided with a powerful screw brake, the handle of which was vertical and was soon found to interfere with the loading of round timber and sleepers. Recently-acquired

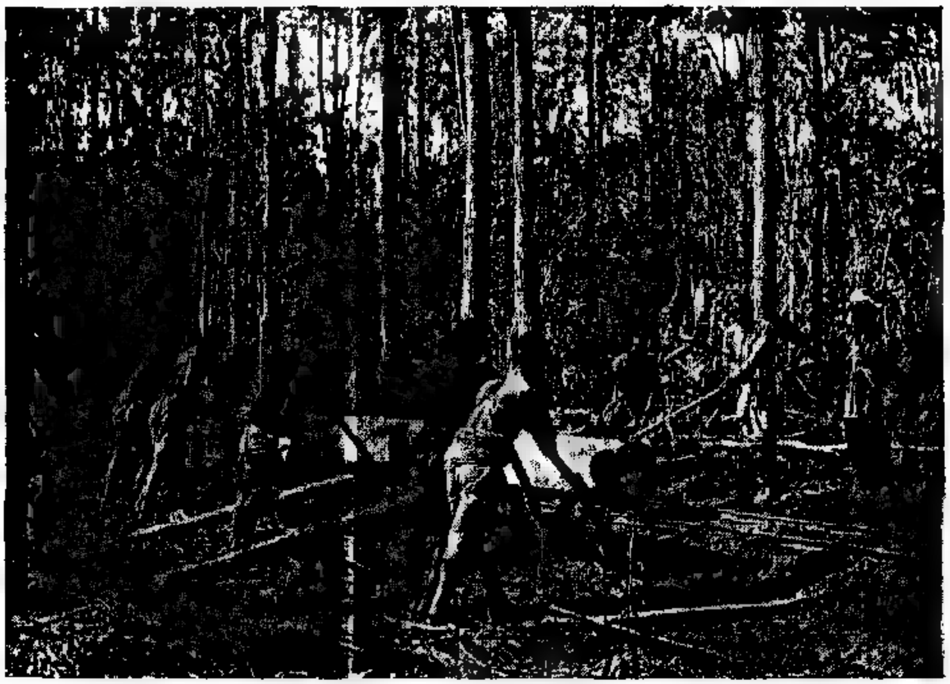

Photo.-Mech. Dept., Thomason College, Roorkee. Photo by W. F. Perrée.

LOADING SHORT TIMBER ON SINGLE TRUCK.

trucks have been fitted with a lever brake which works at the side and can be actuated by a man standing on the load. Gradual improvements of gradients and the regulation of traffic have practically enabled the brakes to be dispensed with. Slight undulations of the surface prevent trucks from running any distance at a high speed. It is obvious that curves should, whenever possible, be on the level, so that trucks which may be travelling in opposite directions may not meet at high speed. On the other hand, gradients which admit of high speeds should be on straight lengths, so that trucks travelling in opposite directions can be seen a long way off.

Sleepers and logs form the bulk of the material transported by the tramway. Plate XXXV shows the loading of long timber on bogies with the use of bolsters which are necessary to enable the load to pass round curves. For short logs the bolster is dispensed with and the timber rests on the angle-iron frame, requiring only to be securely tied down. Plate XXXVII illustrates the loading of short logs. The simplest method of loading is to roll the logs along sloping pieces on to the truck as illustrated. Where a large quantity of timber has to be dealt with, a sloping platform is erected and the logs placed in position by elephants. Of recent years the yield of the coupes has principally been converted into sleepers. Plate XXXVIII shows the process of transport. Each truck is fitted with a wooden frame enabling five M. G. sleepers to be laid side by side; the load per truck consists generally of 25 sleepers = 37 c.f., or 24 cwt. Two men can easily push this load as the gradients are easy and generally with the load.

The total charges to date on the Goalpara tramway of 9½ miles have been Rs. 50,976 or Rs. 5,997 per mile. This includes the initial cost of the line and rolling stock of 18 trucks, with transport from Calcutta to the forests, also laying and maintenance. Part of the work of laying and maintenance was done by labour paid in kind, the value of which is not included; on the other hand, the first five miles of line were bought when steel rails were at an abnormally high figure during 1901-02. It may safely be stated that inclusive of all charges and all labour paid in cash, the present cost of the same plant laid in the forest would not exceed Rs 6,000 per mile.

and that this figure may be taken as the maximum cost of a similar tramway in a remote forest. The following are recent quotations of the cost of plant delivered f.o.b. rail or steamer at Calcutta :—

	Rs.
14lb plant with fish plates, nuts and dog-spikes for wooden sleepers at 33 inches interval	2,600
14lb plant with fish-plates, nuts and steel sleepers at 33 inches interval	3,700
Iron truck with bolster and side brake	100
A set of wheels and four axle-boxes with roller-bearing bolts, &c.	54

(The wooden frame costs Rs. 5 to manufacture locally.)

The Goalpara tramway has never been used to its utmost capacity, the yield of the coupe has occasionally not been fully exploited while the difficulty of procuring labour has always been an obstacle to utilization. The labour difficulty is, however, gradually disappearing, and a complete enumeration of the mature stock affords reliable information in making arrangements well in advance.

The following statement compares the actual cost of transporting the outturn of the coupe of 1905-06, with the estimated cost by other means :

Quantity and kind of produce	Actual cost of transport by tram.			Estimated cost of transport by cart.		
	Rs	a	p	Rs.	a.	p.
23,527 M. G. sleepers (*a*)	1,102	13	2	4,411	5	0
3 sal logs, a distance of 9½ miles . .	1	0	0	3	0	0
1,124 scantlings, &c	17	9	0	35	0	0
51,840 c. ft. of water = 46,650 mds. (*b*) a distance of 6 miles	571	14	0	4,665	0	0
Total .	1,693	4	2	9,114	7	0

(*a*) Sleepers actually cost annas 3 each to cart 9 or 10 miles; the contract rate for carriage by the tramway is 3 pice each.

(*b*) Assuming that a cart will carry 10 mds. a distance of 6 miles for Re. 1.

Photo.-Mechl. Dept., Thomason College Roorkee

Photo. by R. N. Mukerji.

TRANSPORT OF SLEEPERS.

This gives a profit on the tramway of Rs. 7421-2-10 to which should be added the hire of rolling stock to purchasers = Rs. 136-8-0, making a total of Rs. 7,557-10-10, equivalent to 14.8 per cent on the gross outlay. Interest charges and deterioration are not included, but the margin is substantial enough to show a saving on the use of a tramway in the Goalpara forests. It must also be remembered that carts are not procurable in sufficient numbers to work out the entire yield of the forests. In the Eastern Range, with a good road and a lead of 8 or 9 miles, 4 and even 5 annas are being paid per sleeper, yet it is impossible to procure enoguh carts to extract 20,000 sleepers annually. The advantage derived from the tramway chiefly lies in the fact that it has enabled the mature stock to be systematically worked in the dry zone at a distance of 6 miles from water. Without its aid this would have been at the present time quite impossible. Sawyers from Nepal and an ample number of coolies can be imported: transport alone is wanting. The expediency of extending the existing line can scarcely be disputed. The question of laying a tramway in the Eastern Range to connect with the E. B. S. Railway is under consideration.

The life of the line is uncertain, but rails laid in 1901 show no appreciable sign of wear. It is, however, clear that rails which are frequently shifted and relaid temporarily generally on a loose soil, show distinctly more wear than the permanent sections.

I am indebted to Mr. Ram Nath Mukerjee, Officiating Extra Assistant Conservator of Forests, for allowing me to use the photographs shown in Plates XXXV and XXXVIII.

SHILLONG :

30th July 1906.

CONDITION OF THE FORESTS IN THE GODHRA RANGE OF THE PANCHMAHALS DISTRICT AFTER THE DROUGHT OF 1899–1900

BY AMBALAL K. DESAI, RANGE FOREST OFFICER.

Owing to the drought of 1899 and 1900 the condition of the forests in the Godhra Range, which extends over an area of 600 square miles, has been altogether changed, as it has resulted in

killing out to a very great extent one of the most important and predominant species, namely, the teak. Other species of the *injaili* kinds are also dead. Mention of this destruction has already been published in this magazine under the signature of Mr. Pearson, the Divisional Forest Officer, Panchmahals. The forests having been thus ruined, Government took in hand the clearing off of the dead stuff in 1901 with the object of their regeneration. The work has lasted up till now. The result of the working has been that for the first two years, that is 1902 and 1903, the stumps of the dead and dying trees cut out gave new shoots copiously, the underground roots being green. During the cuttings of 1904, however, the regeneration by new shoots was about 50 per cent and in the cuttings of 1905 it was reduced to only 15 per cent. This shows that the drought did its work although there was a rainfall of 36, 3[illegible]·6, 22·3, 45·3 inches in the years 1902, 1903, 1904 and 1905 respectively, the average rainfall of the district being 38 inches. Not only did the roots of the dead and dying trees begin to dry up, but some of the trees which were found green and consequently were reserved at the time of the last four years' marking have now also begun to succumb to the effects of the drought. From this it will appear that the drought of 1899 and 1900 was so severe that its effects have lasted even up till now. Can any one give me an idea of how long they are likely to last?

GODHRA:
8th August 1906.

SUPARI GARDENS AND THEIR EFFECT ON FOREST IN KANARA.

BY RANGER G. S. LAN.

Out of the whole of the Bombay Presidency it is the Kanara District alone which produces "supari" or betelnut in great quantities. This cultivation is for the most part carried on by the Havigs, who are perhaps the hardest working class of cultivators in Kanara. The supari gardens are most common in the Sirsi, Siddapur, and Yellapur talukas, and to some extent in the Supa Petha

The supari tree, *Areca catechu*, requires a fairly temperate climate, a good deal of moisture in the soil, and good shelter from the prevailing winds. Supari gardens are therefore situated in valleys where, as a rule, the above requirements are met. They prosper best on laterite soils.

Ripe betelnuts are plucked from the palms and put out into nurseries, with the husks on, at the commencement of the monsoon and allowed to sprout and remain there for one year, at the end of which period they are put out in the gardens, planted about 5 feet by 4 feet in regular rows, each row alternating with an irrigation trench. These palms are grown in several storeys. This arrangement of plantation maintains a thoroughly complete leaf canopy and keeps the soil always cool and moist.

The system of irrigation requires an ample supply of water at the upper end of the garden to feed the canals. Here it may be mentioned that it is the "kans" evergreens, situated on the slopes of the valley or higher up, which maintain the constant water supply so very important to the very existence of the gardens.

Every year leaf manure, obtained from lopping forest trees, is used for the gardens, the method of application being as follows:—

In the month of June trees are lopped and the lopping is put in cattle-sheds where it gets well trodden down by cattle and mixed up with their refuse. The next morning it is removed to the collecting pit in which some water has been allowed to stagnate and left to rot there until it can be used.

Besides this lopping another kind of leaf manure, locally known as "Nelasoppu," and which is nothing but young herbaceous undergrowth, is used. In some parts this latter kind is applied at the commencement of the monsoon, and the former during the "Magha" rains, *i.e.*, in August. Before applying any manure the earth at the foot of the tree is lightly dug up to form a hold for the manure which is then applied and allowed to continue exposed to rain till September, when it is covered up by earth. This covering of earth is renewed every four or five years, fresh earth being used.

It is a fact that if no manure is applied every year the yield of betelnuts will fall off for some years and then completely fail. The leaf manure obtained from Hirda and Matti is about the best, probably because the tannin producing elements, removed from the soil by the yearly production of betelnuts, is best replaced by the foliage of the two species named above which contain a good proportion of tannin

In former years the garden cultivators used to lop forest trees as they liked, and as a result all the forests excepting the kans in the Siddapur and Sirsi talukas which must have been in a splendid condition before they were meddled with by the gardeners, have now assumed a dilapidated condition and become an ill managed scrub jungle, while the kans have either entirely disappeared or have greatly diminished in area. To remedy this evil and to facilitate proper management Government ordered the assignment of certain forest areas, outside kans, for lopping and made it penal to lop outside these prescribed areas, which were also suitably demarcated. The forest areas thus allotted are locally known as "Bettas." The proportion of such assignment to garden land was something like 4 to 1. The gardeners found, however, that these assignments did not yield sufficient "soppu" or loppings and the number of offences of illicitly lopping in closed forests has consequently steadily increased and the gardeners also raised a cry for more "Betta." So Government recently were obliged to order a fresh assignment, bringing the total areas of "Betta" and garden land to the proportion of 9 to 1.

The supari crop cannot stand heavy rain when it is young and hundreds of bunches are seen dropping down under heavy rain in the month of August. In serious cases the year's crop may entirely fail. In order to mitigate this, the gardeners have devised a new device of sheltering the branches of young betelnuts from rain by covering them over. Experience has shown this to be effective. But the work involves a lot of expense and trouble and sometimes proves fatal to the person doing it, as he has to remain for hours together on the palms moving from one to another, which he does by drawing the neighbouring tree towards him by means of a hook

till it comes within reach when he runs a rope round it and the one on which he is resting and fastens them together. Then he moves on to the other one and removes the rope. For resting on the trees he has a simple contrivance consisting of a small wooden seat to which is fastened a string at both ends. Whenever he wants to rest on a tree he runs the doubled strings round it and passes the seat through the strings at their doubled end and pulls it out till the tree is firmly held in the noose. He can now safely rest on the seat.

SAPA :
17th August 1906.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

IMPORTATION OF RIFLES.

FRESH RESTRICTIONS.

Simla, 25th September.

The following letter has been issued by the Home Department of the Government of India to all local Governments and Administrations :—

SIR,—In continuation of the Home Department letter, dated 20th November 1902, I am directed to forward for information a copy of a notification, dated the 11th September 1906, making certain amendments in the rules issued under the Indian Arms Act, XI of 1878, from which it will be seen that the Government of India have now decided, in supersession of all previous orders on the subject, to prohibit, subject to narrowly-defined exceptions, the importation of all rifles of ·450 and ·303 bores, irrespective of the size of their chamber and action, and consequently of all ammunition which can be fired from such weapons. These exceptions are (*a*) in the case of ·303 rifles, *single* barrelled weapons sighted to over 1,000 yards imported *bonâ fide* for match-shooting purposes, and brought on to the equipment list of the regiment or corps to which the importer belongs by the persons mentioned, and subject to the conditions laid down in Home Department notification No. 1982, dated the 14th May 1903; and (*b*) in the case of ammunition, such reasonable amount as is required for use with weapons of the prohibited bores which are already in the lawful possession of persons in this country. I am to request that this change in the rules may be made widely known to the public and to dealers in arms and ammunition. The change now made in the rules will be embodied in the revised rules under the Arms Act which will shortly be issued.

The *notification runs: In the exercise of the powers* conferred by sections 17 and 27 of the Indian Arms Act (XI of 1878)

the Governor General in Council is pleased to direct that the following further amendments shall be made in the Home Department, dated the 6th March 1879, as amended by subsequent notifications :—Paragraph . : For the words " Rifles of ·303 bore or rifles of ·450 bore of the Martini-Henry pattern, if such rifles have been imported into British India subsequently to the 20th February 1901, without the special sanction of the Government of India, balled ammunition which can be fired from rifles of the bores and pattern aforesaid," subsititute the words " rifles of ·303 or ·450 bore and balled ammunition which can be fired from such rifles." At the end of the first clause of paragraph 1, after the words " carry or possess," add the following proviso " provided also that no prohibition or direction contained in sections 13, 14, 15, or 16 of the Indian Arms Act, 1878, shall apply to persons in possession of rifles of ·303 bore or ·450 bore which have been lawfully imported into British India before the date of this notification."

Paragraph 6, note to rule 5.—For the words " any rifles of ·303 bore or rifles of ·450 bore of the Martini-Henry pattern" substitute the words " rifles of ·303 or ·450 bore."

EXTRACTS FROM OFFICIAL PAPERS.

SOME JAPANESE FOREST LAWS AND ORDINANCES.

REGULATION FOR ENFORCEMENT OF THE LAW OF THE FOREST.

[Our acknowledgments are due to Mr. K. Kita for his courtesy in forwarding us the following interesting papers on Japanese Forest Laws and Ordinances.]

Art. 1.—When a prefectural governor deems it necessary for public forests, forests belonging to Shinto or Buddhist temples, or private forests, to issue the orders provided in Arts. 3, 4 and 55 of the Law of the Forest, he shall inform the circumstances to the Minister of Agriculture and Commerce, after having dealt with the matters.

When a prefectural governor deems it necessary for forests not mentioned in the preceding paragraph to issue the order provided

in Art. 55 of the Law of the Forest, or when it is thought necessary by him to issue the orders provided in Arts. 7, 21 –23 of the same Law he shall report the circumstances to the Minister of Agriculture and Commerce for further instruction.

When a prefectural governor deems it necessary to have a forest afforested by the Government according to Arts 5, 24 and 55 of the Law of the Forest, he shall prepare, after an actual investigation, a memorandum of estimates for afforestation, following the form hereafter shown and forward the same to the Minister of Agriculture and Commerce for further instruction.

In the case of the preceding paragraph, his own view as to the collection of the expenses incurred for the works, or on making the forest semi-State forest, shall be also stated to the Minister.

Art. 2. Any application for conversion of protection forest or a notification thereof issued by a governmental office shall have the account of the investigation relating to the conversion and a plan annexed.

The form of the account of investigation relating to the conversion shall be prepared by the prefectural governor.

Art. 3*A*.—In an application for release of protection forest, or in a notification thereof issued by a governmental office, the reasons necessitating the release shall be stated. But in case a portion of a forest is to be released of protection forest, a plan of the whole and the portion to be released of the forest shall be annexed to the application or notification. On the plan the total area of the forest in question shall be stated.

Art. 3*B*.—When an application has been made for release of protection forest, while, in case it is thought that the reason of conversion has disappeared, an application for conversion has been newly made according to another reason, or the conversion is thought necessary, the prefectural governor shall submit both the conversion and release to the Local Forestry Council.

Art. 4.—When a conversion or release of protection forest which may affect the interests of two or more prefectures is thought necessary by a prefectural governor, the matter shall be notified to the governors of prefectures interested. When a similar

conversion or release has been applied for or notified, the same rule shall be applied.

Art. 5.—When a prefectural governor has received the Local Forest Council's reply as to a conversion or release of protection forest, he shall forward the same, stating his own view thereon, to the Minister of Agriculture and Commerce within thirty days, together with all the records pertaining to the matter.

Art. 6.—When the Minister of Agriculture and Commerce has given a decision on a conversion or release of protection forests, he shall notify it to the prefectural governor interested in the decision. Within ten days after the receipt of the decision by the governor, it shall be published in the prefectural gazette, made public by a notification on the bulletin board at the front of the City, Town or Village Office in whose jurisdiction the forest is situated, and the owner of the forest shall also be notified.

But as to conversion, the outline of works in the account of investigation relating to the conversion shall be annexed to the information.

Art. 8.—If there be non consent as to the price of the protection forest to be purchased by the Government or in regard to the sum of compensation mentioned in Art. 26 of the Law of the Forest, the prefectural governor shall submit the matter to the Local Forest Council and notify the price or sum of compensation voted by the Council to the parties concerned.

Art. 9.—Whosoever asks for the compensation or the subsidy mentioned in Art. 26 of the Law of the Forest shall forward a bill stating the sum to be claimed with particulars of calculation to the Minister of Agriculture and Commerce through the prefectural governor.

Art. 10.—The information mentioned in Art. 31 of the Law of the Forest shall be made to the police court governing the locality where such work or business is to be carried on, with a written statement together with the shape of sign and impression of seal.

The local police court shall notify such information as mentioned in the preceding paragraph to the Minor Local Forest Office.

Art. 11.—Any person who desires to obtain the permission to set fire in a forest shall apply to the forest officials or police officials, appointing the date for setting fire.

When, however, the whole or a portion of the forest where fire is to be set belongs to another person, a document proving the consent of the owner or his agent shall be annexed to the application.

When permission has been given to set fire the permission note hereafter shown shall be handed to the applicant.

Art. 12. The applicant must bring the permission note with him to the scene on the day when the area is fired.

Art. 13.—Any person who desires to set fire in a forest or a plain connecting with a forest shall previously give notice of his intention to the owner or manager of the land adjoining the place where fire is to be set.

Art. 14.—When it is likely that fire may spread beyond the tract, the forestry officials or police officials shall order the applicant to stop the firing, to change the method and date of firing and to make proper works and preparations against the spreading of the flames.

ORDER OF THE DEPARTMENT OF AGRICULTURE AND COMMERCE.

Art. 1.—The term "manufacturers of principal manufactures" in the Imperial Ordinance No. 363 denotes the persons engaging in the manufacturing business of the following articles:—

1. Paper, its materials.
2. Matches, their materials.
3. Wood shavings, their materials.
4. Camphor, camphor oil, and other similar fluids.
5. Sleepers.
6. Shiitake (a kind of mushroom).
7. Tannin, its materials.
8. Bird lime, its materials.
9. Lacquer-ware, its materials.
10. Timbers, various boards, cask and barrel materials, for export.

11. Package case, its board.

12. Bamboo, and bamboo-ware for export.

13. Charcoal for export.

Art. 2.—Manufacturers of principal manufactures who have either of the qualifications under-mentioned and are full of confidence or trustworthy are entitled to purchase, by an ordinary contract, the products of State forests and plains for the materials for their manufactures.

1. Any company which has carried on for over one year, the manufacturing business of the principal manufacture requiring the materials which it desires to purchase from the Government, and whose capital exceeds thirty thousand yen.

2. Whoever, not a company, has carried on for over one year, the manufacturing business of the principal manufacture requiring the materials which he desires to purchase from the Government, and receives an annual gross profit exceeding two thousand yen.

3 Any person who has carried on the manufacturing business of articles for export requiring the materials which he desires to purchase from the Government, and whose capital exceeds thirty thousand yen.

Art. 3.—Timber traders who have either of the qualifications under-mentioned and are full of confidence or trustworthy are entitled to purchase, by an ordinary contract, the principal products of State forests.

1. Any company which has carried on the timber trade for over two years and whose capital exceeds fifty thousand yen

2. Whoever, not a company, has carried on the timber trade for over ten years and pays the business tax to the amount of more than five yen.

IMPERIAL ORDINANCE NO. 363.

Products of State forests and plains may be sold by an ordinary contract in the following cases only :—

1. When necessary for public use or for works of public interest.

2. When the materials for building or fuel are sold for the sake of the sufferers by an extraordinary calamity.

3. When the materials for fuel and secondary products are sold to the residents in the vicinity of the forest or plain, in accordance with the customs and usages.

4. When the products of a forest or plain entrusted are sold to the trustee.

5. When the products of a semi-State forest are sold to the forest-planter.

6. When the products of a forest once belonged to a Shinto or Buddhist temple, but confiscated to the State, are sold to the temple as building materials.

7. When the products are sold to the contractors of works in State forests and plains, or to the purchasers of the products of them, for the necessity of carrying on their business or works.

8. When season products of secondary importance are sold.

9. When the products necessary for mining are sold to miners.

10A. When the products of the forests and plains converted, sold, leased or transferred without compensation, according to the provisions of Arts. 3, 8, 11, and 15 of the Law for Administering State Forests and Plains are sold to the manager of the land converted, purchaser, lease-holder or transferee.

10B. When the products are sold as materials to the manufacturers of principal manufactures who have the qualifications fixed by the Minister of Agriculture and Commerce.

10C. When, in case it is likely to impede the improvement of a forest if the scheme of felling derived from the Working Plan is to be executed by means of a competitive contract, the principal products of the forest are sold to the timber traders who have the qualifications fixed by the Minister of Agriculture and Commerce.

11. When the products of a forest are owned by a private person but the trees thereon belonging to the State are sold to the owner of the land.

12. When the stones for the use of building or other purposes are sold to their discoverer.

13 When the product whose estimated price shall not exceed three hundred yen a e sold

IMPERIAL ORDINANCE NO. 32.

Only for the purpose f export, the sale, by an ordinary contract, of the products of State forests under the control of the Department of Agriculture and Commerce may be entrusted to a wholesale merchant.

Wholesale merchants to whom the sale mentioned in the preceding paragraph may be entrusted must have either of the following qualifications :—

1. Those who pay the business tax to the annual amount of more than two hundred and fifty yen.

2. Any company or partnership for which the contributions consisting of capital and money have been paid up to the total amount of more than fifty thousand yen.

3. As to the residents abroad, those who are considered by the Imperial Consul residing in the locality where they must have a property of more than fifty thousand yen and be full of confidence.

Bemrose, Collo Derby

Photo G S Hart

SANGLA BRIDGE, BASHAHR STATE, N.W. HIMALAYAS

VOLUME XXXII. NUMBER 11

INDIAN FORESTER

NOVEMBER, 1906.

RECRUITMENT AND TRAINING OF CANDIDATES FOR THE PROVINCIAL AND SUBORDINATE FOREST SERVICES.

We have devoted some attention in the pages of this Magazine to the training of probationers for the Imperial ranks of the Service, a matter which cannot as yet be considered as finally disposed of. We now propose to turn our attention to the Provincial and Subordinate ranks. In a recent Resolution of the Government of India, published elsewhere in this number, the revised rules for the training of these latter officers are issued, and we would congratulate the Government on the extremely enlightened and progressive character of the new departure—a departure which, we feel assured, will be received with the greatest satisfaction by the Department at large.

There can be little doubt that the constitution of the Provincial Service and even that of the Ranger class has scarcely attained *that success which its initiation some years ago was hoped to* secure. The reasons are not far to seek. In many circles seniority quite as much as professional attainments and merit, was taken

into account in promoting men both in the Ranger class and, more invidious still, from the Ranger class into the Provincial Services. The results of this policy soon became apparent. Divisional Officers found themselves saddled with assistants in the Provincial grades who had little real professional knowledge and who were consequently, in spite of their rank, only fit or scarcely fit to hold charge of a range. Conservators, on the other hand, were forced to place these men, owing to the short-handedness of the Imperial Service, either in temporary charge of divisions during the absence of the incumbents on leave or in permanent charge of the smaller divisions of their circles; a proceeding which practically saddled the Conservator with the administrative charge of divisions. This state of affairs has entailed upon the officers concerned a large amount of work quite outside their respective provinces. This fact had become well known, and we read in the Resolution that from the reports submitted by Local Governments the Government of India had learned that "there is a general feeling of dissatisfaction with the existing standard of qualifications of the members of the Provincial Service."

The method of filling the lower grades of the Provincial Service also resulted in grave dissatisfaction in the ranks of that Service. The promotion of men of long service in the Ranger class meant the filling up of the ranks of that Service with men who could never hope to reach the higher grades and considerably retarded the promotion of younger men whose qualifications and attainments were such as warranted their being assured of an equable flow of promotion. To attain this latter object and to ensure that the Provincial Service shall be manned in the future by men of good education and good social standing, the following system has been introduced, and it is one which is sure to meet with the entire approbation of both the Conservator and the Divisional Officer.

Local Governments are now empowered to select candidates for direct appointment to the Provincial Service, and in order that such specially selected candidates may acquire the higher qualifications necessary to fit them for the duties of that Service, it has been arranged that a third year's course, both theoretical and

practical, shall be inaugurated at the Forest College The candidates may be selected either before or after completion of the ordinary two years' curriculum, but they must have obtained the Higher Standard certificate of the College for the two years' course; and before appointment to the Provincial Service they must have obtained a certificate from the Principal of the College to the effect that they have satisfactorily completed the third year's training A candidate selected by the Local Governments for direct appointment to the Provincial Service may be granted a stipend not exceeding Rs. 100 per mensem during the three years' course of training, and when he has satisfactorily completed the course he may be posted to the service either as a Ranger or (and we hope that this latter will be the usual procedure in the cases of direct appointment, since we think candidates trained in this way should never serve in the subordinate ranks) as a probationary Extra-Assistant Conservator; he will however be required to serve for at least three years' satisfactory service before being appointed permanently to the Provincial Service How the probationary period should be passed and whether for a longer period than three years is left to the decision of Local Governments. For the first three years the probationer may be given a salary not exceeding Rs. 150 per mensem and thereafter Rs. 200 per mensem. Further to the Local Governments is left the decision as to whether such probationers should be granted permanent appointments, and also—a most important point—as to whether any proportion of the vacancies in the Provincial Services should be guaranteed to candidates of this class.

This latter question is one which requires the most careful consideration, and we would advocate that a certain proportion of such vacancies should be so set aside. It seems to us that to ensure the success of the scheme a certain assured flow of promotion should be safeguarded in order that there shall be no chance of a block and consequent dissatisfaction creeping into the ranks of what should, in a few years' time, prove the cream of the Provincial Service; for the advent of such will inevitably reclose the ranks of the classes the new proposals aim at opening to the Department.

We turn now to a consideration of the Ranger class. The main object of the ordinary two years' course at the Forest College is to give these men such an education as will fit a candidate for appointment as Ranger. At the close of this period of two years an examination will be held, on the results of which three classes of certificates will be issued, known respectively as the Honours, Higher Standard and Lower Standard certificates. Candidates will be admitted to this course in accordance with the College rules.

We have seen that the new system prescribes a third year's course at the College designed to fit the student for early appointment to the Provincial Forest Service. It has been decided that Local Governments or Native States shall have the power to request that any selected Ranger may be given the third year's course at the College either without having obtained the Higher Standard certificate or some time after he has so passed from the College, the only proviso being that the Principal must be satisfied that the student's qualifications are such as to enable him to benefit from the course of instruction desired and that there is room for him at the College. It may be here remarked that the same applies to private students who are prepared to defray their own expenses. With reference to the appointment to the class of Ranger, Local Governments will in future make their own rules subject to the following conditions. The rules should provide for the appointment as Rangers of subordinate officials of long service and tried ability and probity in order to encourage efficiency among Deputy Rangers and Foresters. In such cases promotion will be made without reference to the special training such officers have undergone or to any educational certificates they may have obtained, but subordinates selected for this promotion may be required to undergo a special course of training or to pass specified examinations before being made permanent in the Ranger class. Direct appointments to the Ranger class will, however, in future be only given to trained candidates who have obtained the Higher Standard certificate at the end of the two years' course at the College. Local Governments are empowered to give a stipend not exceeding

Rs. 50 per mensem to all candidates selected by them for the two years' course, whether already in the service or not.

In order to ensure high efficiency in the Ranger class, the Government of India think it of great importance that officers of that class should remain eligible for promotion to the Provincial Service, and have accordingly ruled that Local Governments may in future appoint to the lowest grade of Extra-Assistant Conservator any selected Ranger of long service and tried ability and probity irrespective of the educational certificates he may hold but subject to any special training the Local Government may decide on.

In this connection the Government of India ask Local Governments to consider whether in their opinion the introduction of the new class of selected candidates for direct appointments to the Provincial Service will diminish the prospects of promotion of the existing staff of Rangers, and that, should this prove to be the case, they will be prepared to consider any definite proposals on the subject which Local Governments may be prepared to submit. We would suggest that a separate cadre be introduced on which should be borne Rangers of long service promoted to the lowest grade of Extra-Assistant Conservators, and also, and more important still perhaps, those who have already been promoted into the Provincial Service and whose promotion has been made more on seniority lines than with reference to their professional ability. This cadre would be kept in force until all the old untrained or inadequately trained Rangers had left the Service, when it would be possible to assign a certain number of the lowest grade Extra-Assistant Conservatorships in the Provincial Services of the various provinces to be filled by Rangers of long service who had risen from the Deputy Ranger and Forester grades. The introduction of a separate cadre would entail an extra expenditure for a few years, but it would assure the prospects of the highly trained members of the Provincial Service leaving Dehra Dun under the new regime and avoid blocking their promotion. In our opinion the whole future of the scheme depends upon this latter. The men who successfully pass the three years' course are the men who will and should fill the upper

ranks of the Provincial Service and we think that all Conservators and Divisional Officers will wish to see them filling them within a reasonable time.

To meet the peculiar circumstances of Burma, which already possesses a Vernacular Forest School of its own, the Government of India have decided that, pending the establishment of an English course at that school, Conservators may make direct appointments as probationary Rangers of natives of Burma with a knowledge of English on a pay of Rs. 75 per mensem. Men so appointed will be on probation for two years, after which period they may be confirmed by the Local Government, but will not be eligible for an appointment on more than Rs. 100 per mensem until they have obtained a Higher Standard certificate in the English course at the Burma Forest School or at the Forest College. Candidates selected for direct appointment to the Burma Provincial Service may undergo their first two years' training at the Burma Forest School, but must complete the third year's course at the Forest College and must thereafter remain on probation for three years during which they may be given a salary not exceeding Rs. 175 per mensem and thereafter Rs. 200 per mensem.

It is impossible to minimise the importance of the new departure nor the wide-reaching effects it will have on the efficiency of the Provincial Service. Since the general introduction of Working Plans entailing the more intense and systematic working of the forests of the country year by year the work thrown on the Divisional Officer, and *ipso facto* on the Conservator, has become heavier, whilst the necessary trained assistance he has required from his subordinates has remained almost stationary or has certainly not increased in the ratio required. Throughout the length and breadth of the country the cry has been the same, and it is no secret that the backwardness of many fine and valuable forest divisions is entirely due to this fact. The efficiency, expansion, economic working and financial improvement which are likely to occur when the effects of the new departure have begun to make themselves felt are likely to prove incalculable. To ensure their permanency however it will be necessary to take a further step and improve the

conditions of service and emoluments of the Provincial Service. Men of the stamp required will, after undergoing the three years' training at Dehra, look for better prospects than the Provincial Service at present offers them. We trust therefore that the Government of India will find it possible to supplement their liberal offer of free education by an improvement in the conditions of service and emoluments of the grades whom the higher training is designed to benefit.

The resolution has also some remarks on the efficient training of Deputy Rangers, Foresters and Guards The Government of India consider that this matter should now be left to Local Governments and has accordingly decided to abolish the Vernacular class hitherto maintained at the Forest School at Dehra Dun. They trust that all Local Governments will make satisfactory arrangements for the training of the Subordinate Executive Service below the rank of Ranger. We have already discussed this question in these papers and its importance cannot be overstated. The best trained and most efficient Imperial and Provincial Services will not yield the results desired if the subordinate executive ranks are allowed to remain in their present condition just as it has been recently discovered that the finest officered army in the world is useless unless attention is paid to the education of the rank and file

We trust ere long to be able to record in these columns the steps taken by Local Governments to remove the present inefficiency of the subordinate executive staff. The Conservators and Divisional Officers in the various provinces have doubtless already made up their minds as to the amount of training required and the best steps to take to ensure this part of the establishment being brought into line with the general efficiency aimed at throughout the Service as a whole.

SCIENTIFIC PAPERS.

THE EFFECT OF THE MOON'S PHASES ON THE PERIOD OF FELLING BAMBOOS.

BY E. P. STEBBING.

It has been a matter of common knowledge for some decades past amongst those who have had any connection with the cutting and export of bamboos in India, and to a certain extent of poles as well, that the natives have long held a superstition that neither the one nor the other should be felled when the moon is full; they argue that the sap is then very abundant, and unless the bamboos are well soaked in a tank and subsequently preserved with plenty of smoke they will be rapidly destroyed by boring insects (*ghoon*). The most serious of these pests are the bostrichid beetles *Dinoderus pilifrons* and *D. minutus*.* This curious theory is held so commonly throughout the country that I have been for some years past endeavouring to ascertain the causes which have given rise to it, the reasons upon which it is based, and whether any scientific facts can be adduced in its favour.

One of the explanations put forward is to the effect that the *ghoon*, like many other wood-boring insects, prefers to lay its eggs in wood which has commenced to wither and which consequently no longer has a healthy flow of sap to interfere with the insect in its burrow. This being so the time immediately after the bamboo is cut down would be the most likely one for it to be attacked.

It seems to be a generally received idea that soaking bamboos, as also other timber, in water for a considerable time immediately after it has been felled, makes it less liable than it would otherwise be to suffer from boring beetles of all kinds. It is supposed that not only does the water prevent the beetles laying their eggs during the time the wood is immersed in it but that it also drowns insects already at work and dissolves much of the nutritive matter on which they otherwise feed.

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* *Vide* my Notes on the Preservation of Bamboos from the attacks of the Bamboo Beetles or Shot Borer. *Indian Forester*, App. Series (1903). *Ibid* XXXI, 249.

That bamboos, once sickly and dying or dead, suffer largely from the attacks of beetles must be obvious to the most superficial observer who glances over a bamboo clump or examines furniture, houses, fences, etc., built entirely or partially of bamboos. We are not here concerned, however, with this aspect of the question; our purpose being to discuss the information at present available as to the effect the felling of bamboos and posts at different phases of the moon has upon their subsequent immunity or otherwise from the attacks of boring pests.

In their Forest Proceedings * the Madras Board suggested in 1898 that investigations should be carried out in this subject and the experiments initiated as a result, although made in a few divisions in Madras only and in a manner which leaves room for improvement, are of very considerable interest as serving to show that the so termed superstition of the natives of the country has perhaps some substratum of solid fact to rest upon.

Before detailing the various experiments made in this country I will first refer to a paper read by Ernest R. Woakes before the American Institute of Mining Engineers † in which the author stated that in South America (Columbia) *not only bamboos but all trees* are felled during the waning moon only and not during its increasing phases. It would appear that in that country the effect of the moon's phases is treated as an accepted fact. Mr. Woake states from his own experience that he has often seen the sap running out of stumps during the increasing moon which were absolutely dry during the waning moon.

In a letter‡ on the subject Mr. A. W. Peet, Acting Conservator of Forests, Central Circle, Madras Presidency, made the following remarks in 1899 :—

" As regards bamboos I expect that the question of durability depends to a great extent on the question of sap, but the problem seems to be complicated by the doubt whether we are to reckon

* *Board's Resolution*, Forest No. 255, dated 24th June 1898.

† This paper was reprinted in the *Tropical Agriculturist* for October 1899.

‡ No. [illegible]54, dated Madras, 2[illegible]th October 1899, to the Commissioners of Land Revenue, Madras.

with the effect of the moon's phases, as well as with the period of the year at which they are felled. I doubt if even the borer can subsist without the elements of the sap on which to feed, and the principle of soaking bamboos is, I think useful, chiefly because it tends to dissolve the fermenting constituents. Heating and smoking bamboos are additional precautions generally adopted.

"The point, however, which I wish to emphasise here is whether we should not primarily consider the period of the year at which bamboos are felled, and only secondarily the period of the month. There seem good grounds for paying attention to the latter, if we can only determine definitely the number of days in a month in which bamboos can be felled with confidence, and I will revert to this point. However, I think that unless strong evidence is adduced to the contrary, we shall treat bamboos like other vegetation and assume that the period when the sap is most vigorous and therefore the fear of fermentation most pronounced, is in the spring, and that this season should be avoided for felling if durability is of importance; and it may even be a question whether the root stocks will not be more injured during this period.

"In order to test this presumption I lately questioned a bamboo contractor, without giving him any leading questions, and he told me that he believed that there was something in the waning moon theory, but that he had come to the clear conclusion that bamboos felled during March and up to the end of July had less durability than those felled during the other months of the year.

"As regards the phases of the moon a hill man told me that he considered that bamboos might be felled safely during the seven days before new moon, and the seven days after; but on being pressed as to what he considered absolutely as the best period he said during the seven days before. His theory of the seven days after would seem to conflict with Mr. Woakes' theory."

The experiments carried out in Madras, although they cannot be considered to have been as definite as is desirable, are still of very considerable interest. They were initiated in four separate localities, *viz.*, the Nilgiris, North Coimbatore, South Coimbatore

and South Malabar, and the following summarises the observations made.

NILGIRIS:

30th June 1899:

Bamboos were cut in all the Ranges except Ootacamund a few days before and a few days after new moon and full moon and kept separate from each other. Some were smoked and others were soaked in water. It was found that bamboos cut on dark nights and immediately soaked or smoked for a period of two months were not attacked by the borers. From the experiments conducted in the various ranges it was observed that bamboos *felled during moonlight nights were more severely attacked than* those felled during dark ones. That soaked bamboos fared much better than unsoaked ones As a result of the experiments the recommendation was made that as soon as felled the bamboos should be fully immersed in water for some time or properly smoked in a shed, or otherwise they were liable to be attacked by the borers.

As I have shown, however, in my previous papers on the preservation of bamboos from the borers, neither immersion in water nor smoking are to be depended upon as safe preventives.

NORTH COIMBATORE:

24th August 1899.

A series of experiments were conducted in the Satyamangalam Depôt at the foot of the Ootacamund Hills. During each week of the month one head load of 25 bamboos of two *kinds (dry solid bamboos known as* 'Karanai' and green hollow bamboos known as 'Varar') were set aside and marked. It was observed that dry bamboos appeared to withstand the attacks of the borers better than the green In every case the insects attacked the bamboos in the inside of the bundle first, *i.e.*, those not exposed to light. This is a general rule amongst these boring beetles who very generally, although by no means always, attack in the shade in preference to strong light.

As a result of the experiments conducted here it was held that the phases of the moon had no effect on the felling season.

It was noted, however, that bamboos exposed to light and air are less liable to attack than those not so exposed.

SOUTH COIMBATORE.

18th February 1899 *and* 1*st November* 1899.

A series of experiments were made on two occasions at Mount Stuart, one from the 2nd August to 1st September 1898, and the second from the 10th March to 12th April. On each occasion 10 large bamboos (*Bambusa arundinacea*) and 10 small (*Dendrocalamus strictus*) were cut daily. Each bundle of 10 was labelled and the bundles were all laid out in a row. Those cut on the first occasion were examined one by one on 2nd February 1899 with the result that the influence of the different phases of the moon did not appear to have any bearing upon the presence or absence of the borers. On the second occasion one half of the length of each bundle was covered with mats, the other being left uncovered. This was done in order to observe the effects of shade as a protective influence or otherwise to the bamboos. The bamboos so treated were examined at the beginning of October. It was found that the portions of the bamboos covered over by the mats had double the number of boring insects at work in them than were to be found in the uncovered portions. Thus the insects attack bamboos stacked in the shade twice as heavily as those stacked under the full rays of the sun.

The following were the percentages of attack observed in the case of the two species of bamboos experimented with:

Bamboo.	Percentage attacked by borers on the first occasion	Percentage attacked by borers on the second occasion.
Bambusa arundinacea . ..	50·53	34·33
Dendrocalamus strictus	39·47	41·66

It will be noted from the above that the percentage of attack in the case of *Bambusa arundinacea* varies considerably, being much higher in the case of the bamboos cut in August than in the case of those cut in March-April. In the case of *Dendrocalamus strictus*, however, the percentage of attack differs but little, the

increase inclining to those cut in the spring months of the year. To be conclusive, further experiments with a larger number of bamboos should be carried out in this Division.

SOUTH MALABAR:
4th October 1899.

A series of experiments were made from 2nd August 1898 to 7th April 1899, both at the full moon and new moon periods. On each occasion a bundle of 25 bamboos was soaked in mud and water whilst a second bundle was merely stacked. The experiments seemed to show that neither the soaking nor felling at any particular phase of the moon had any marked effect in preserving the bamboos from the attacks of the borers. It was noted, however, that the bamboos felled during the months of January, February and March were not attacked by the borers, stacked bamboos felled at other periods being invariably attacked.

The above summarises the experiments as far as they appear to have been carried in Madras. They support and confirm observations of my own on two points :—

(*a*) That the cold weather months are the best ones in which to fell, although felling at this season does not guarantee immunity to the bamboos from the attacks of the borers.

(*b*) That bamboos stacked in the shade or covered up in such a manner as still to allow of the beetles getting at them will be more severely attacked than those stacked in the open.

The question as to the best time in the month to fell requires a more detailed series of experiments to be carried out before we can finally say that the belief so commonly held in India is a mere superstition. It will be noted that in the Madras experiments the bamboos kept under observation were either *stacked together* or the bundles were placed in rows *adjacent to one another*. Now this procedure greatly detracted from the value of the experiments carried out, since it is possible, if not probable, that the bamboos cut at a certain period of the moon's phases first attracted the beetles which, appearing in numbers too great to find accommodation in the bamboos in the condition they preferred, overflowed on to and attacked neighbouring bundles which otherwise might have

escaped. If the experiments are to be reliable, it is necessary to cut bamboos at different periods in the month from the same clump or forest and to stack the lots cut on different dates at considerable distances apart so that the danger of the lot in the condition preferred by the beetles attracting the insects to the others will cease to exist.

A study of my note on the life-history of these insects will show that the beetles do not appear on the wing in December and January at least, in the more southern portion of the Continent, and for an even longer interval in the northern portions. This therefore accounts to some extent for the immunity of bamboos from attack at this period.

In order to settle the question of the effect of the phases of the moon on the period of felling, I would ask those interested in the subject to initiate a series of experiments as follows :—

(*a*) Bundles of bamboos to be cut weekly, each week's felling to be numbered and stacked *separately* as far apart as possible (at least a mile).

(*b*) The phase of the moon at the period of felling to be accurately noted.

(*c*) Particulars as to locality, elevation, etc., to be noted for each bundle cut.

(*d*) The bundles to be inspected *weekly* and rough notes as to the percentage of each bamboo attacked to be noted down for each week.

(*e*) The species of bamboo experimented with to be accurately noted.

(*f*) My own theory at present is that bamboos felled *during November and the first half of December* and *immediately piled* or *stacked in the sun* will not be attacked by the borers. I should like a verification of this by experiments carried out in different parts of the country.

It would lay me under a deep obligation if all who institute such experiments would forward me* a copy of their notes and observations together with the deductions they draw therefrom.

* To Dehra Dun, United Provinces.

ORIGINAL ARTICLES.

IMPROVEMENT FELLINGS AS A METHOD OF TREATMENT IN IRREGULAR FORESTS.

"At the close of 1903-04 the areas for which Working Plans had been compiled and sanctioned amounted in Bengal to 24,407 square miles, in Madras 5,103 square miles, and in Bombay 4,170 square miles, or a total of 33,680 square miles".*

The different sylvicultural systems or methods of treatment prescribed in the Working Plans for the systematic working of these forest areas do not cover a very large or varied field. Indeed, in high forests, with the exception of the Selection system, the only other method of treatment which appears to have received a strong measure of support is that described as the method of "Improvement Fellings". This method is applied over no less than 10,927 square miles of systematically worked forests. In other words, about one-half of the total area under Working Plans in the Bengal Presidency is at present subjected to a regulated system of management, somewhat varied, but brought under the common designation of "Improvement Fellings." The method of Improvement Fellings thus occupies an important position in indigenous Indian Forestry. Nevertheless, the term remains undefined; and as a method of treatment in irregular forests, no attempt has been made to give it a recognised place in British forest terminology. Dr. Schlich in his Manual of Forestry appears to make no mention of Improvement Fellings, either in connection with cleanings and thinnings and other works of improvement, or as a sylvicultural system. In France, on the other hand, "coupes d'amélioration" and "travaux d'amélioration" are recognised technical terms frequently employed in forestry to denote particular supplementary forest operations. By "coupe d'amélioration" is understood cleanings (coupe de nettoiement) and thinnings (éclaircies périodiques)†;

* Review of Forest Administration in British India for 1903-04, with a Quinquennial Summary, by S. Eardley-Wilmot.

† Culture des bois, B. Lorentz and A. Parade.

whilst under the designation of "travaux d'amélioration" are included all works necessary for the improvement of the forest, consisting "soit en repeuplements artificiels, soit en fossés d'assainissement, soit en création ou réparation des voies de vidanges sans lesquelles les produits de certains peuplements resteraient indubitablement invendus"*.

The term "Improvement Felling" was undoubtedly introduced into British India by Foresters who had received their early training at the Nancy School of Forestry; and when first adopted as an Indian technical forest term its signification appears to have been that given by French Foresters to "coupe d'amélioration". In Bagneris' Manual of Sylviculture†, translated in 1876 by two distinguished Indian Forest Officers, and prescribed as the Indian text-book, Improvement Cuttings are defined as cleanings and thinnings. Again, in the published list of Forest Technical Terms, adopted by the Forest Conference held at Dehra Dun in 1886, the Improvement Felling is defined as a "coupe d'amélioration" or "verbesserungsschlag". In the form prescribed in the Forest Code to be used in drafting Working Plans,‡ after describing the method of treatment to be applied to the principal fellings, the supplementary regulations are dealt with; and these include "cleanings, thinnings and other improvement fellings" as well as "improvements common to the whole area", clearly indicating that these Improvement Fellings were merely to be subsidiary or supplementary operations, that is "coupes d'amélioration", and "travaux d'amélioration". So far there appears to have existed a considerable and powerful concensus of opinion in favour of defining and restricting the application of the term Improvement Fellings to minor cultural operations.

This interpretation is still further brought out in Mr D' Arcy's handbook on the preparation of Forest Working Plans, issued from the Office of the Inspector General of Forests to the Government of India. "When it is sought to improve or restore the condition

* Cours d'aménagement des Forêts. Henri Nanquette

† Manual of Sylviculture by B. Bagneris, translated from the French by Fernandez and Smythies, Asst. Conservators of Forests, Central Provinces.

‡ Forest Department Code 6th Edition, Article 89 (1).

or constitution of an existing crop by thinning or weeding the operation is called an Improvement Felling"*. Again, "it is frequently necessary to improve the condition of the existing crop, or re constitute the former capital, by carefully respecting the main crop and by limiting operations to the cutting out of ill-grown or injured species, injurious climbers, etc., without altering the method of treatment or the mode of reproduction. The treatment temporarily applied in such cases may be called a restoration, and the fellings restoration fellings"†.

It would be easy to amass further evidence to show that on the formation of a British Indian forest terminology the term Improvement Fellings was merely applied to denote thinnings, cleanings or weedings; subsidiary or supplementary operations undertaken with a view to the proper tending of the forest. The same interpretation with perhaps a slight addition appears to have been accepted by the Bureau of Forestry of the United State of America, where the science of forestry is of even more recent origin, the terms of forestry having doubtlessly been largely derived from British sources. In a recently published bulletin of "Terms used in Forestry and Logging"‡ "Improvement Cutting or Thinning" is described as "usually being the first thinning made when a forest is put under management, to prepare it for the application of a regular system"; and the reader is further referred to "Thinning" which is defined as "the removal of a portion of the trees with the object of improving the stand without inviting natural reproduction. The following kinds of thinnings being distinguished cleaning, improvement thinning, accretion thinning".

In 1891 the second edition of Mr. Fernandez's Manual of Indian Sylviculture was published. In it the author first makes an attempt to describe "Improvement Fellings" as a systematic or regular method of treatment to be applied to irregular woods. Mr. Fernandez, however, does so in a somewhat uncertain spirit, the

* Preparation of Forest Working Plans, by W. E. D'Arcy.

† "The term 'improvement' applied to such fellings is also too vague." *Idem* The reader's attention is invited to Mr. D'Arcy's description of the Selection system "limited by cultural rules", pages 82 and 83 of his text book.

‡ United States Department of Agriculture Bureau of Forestry Bulletin No. 61.

method being dealt with under the head of works for the "Maintenance and Treatment of Forests," in connection with fire-protection, cleanings, and thinnings. In defining the term "Improvement Fellings", Mr. Fernandez does not appear to transgress any previously accepted teachings. An improvement felling is defined as "an operation made in heavily damaged forest with the object of removing from them, as quickly as practicable, all unsound, deteriorating, knotty, inferior or harmful trees, while at the same time making the most of existing material, in order to obtain as full a crop as possible composed principally of healthy, vigorous growing trees of valuable species". Nevertheless, the manner in which Mr. Fernandez proceeds to elaborate his thesis is not as happily conceived. It is laid down that "an improvement felling is not an elementary operation of a special kind not yet described in this Manual, but is essentially a composite one combining in itself the attributes and objects of every kind of felling already treated of. At points where utilisable advance growth exists, it will assume the character of an after felling or of a jardinage cutting. Where the crop is too dense it will become a preparatory felling or a thinning or a cleaning according to the age of the component individuals. In other places it may partake of the nature of a seed-felling. Where frost and other dangerous atmospheric influences are not to be feared and the soil cannot suffer from exposure, there a more or less large clearing may be made if the whole of the standing stock is unsound or deteriorating and early regeneration is certain"*. An element of uncertainty is thus at once introduced. Whilst Mr. Fernandez undoubtedly prescribes the removal merely of "unsound, unhealthy, deteriorating or harmful stuff", either at once or gradually according to the sylvicultural requirements of the forest; to the uninitiated the term "Improvement Felling" as above defined would appear to justify the removal of any stem, sound or unsound, as long as early regeneration is certain. In other words, preparatory, seed, or final fellings may be carried out in the oldest age classes with cleanings and thinnings in the younger classes. Thus in a step the "Improvement Felling" from a simple

* A Manual of Indian Sylviculture by F. G. Fernandez, Indian Forest Service.

cleaning or thinning supplementary operation, a 'coupe d'amélioration", has come to signify the application of "every kind of felling (system) treated of" in a Manual of Sylviculture. Whether this interpretation can be rightfully fathered on Mr. Fernandez,* the fact remains, as will be clearly proved from a perusal of existing sanctioned Working Plans, that two schools of Indian Sylviculturists have been formed. The one school accepts Mr. Fernandez's proposition *in toto*. The removal of all trees of the exploitable size (arbitrarily fixed) is permissible, as well as the carrying out of preparatory and seed fellings, and thinnings, cleanings, and weedings. The second school, on the other hand, restricts the term "*Improvement Fellings*" *to thinnings and weedings*. "The weedings to consist in cutting out unsound trees, or trees of inferior species standing over good sapling growth or flourishing reproduction. Low shrubs may also be cut to help existing seedlings; but this must not be done with a view of obtaining reproduction, but only *to help that already established, for the time for the reproduction of* the forest has not come" †. Herein lies the crux of the whole question. It has been said that the aim and object of every sylvicultural system consists in harvesting the crop, whilst at the same time assuring the reproduction or regeneration of the forest—"there is nothing that needs to be more *strongly emphasized than that the* main business of the Forester is expressed in the one word "reproduction"; his main obligation is the replacement of the crop he has harvested, whether produced by unaided nature or otherwise, by as good if not a better crop of timber than he found"‡. The one school then accepts the *so called method of improvement fellings* as a regular sylvicultural system,§ by means of which the harvesting of

* Mr. Fernandez writes in his preface to the second edition of his Manual: "It was my intention to rewrite also the chapter on Improvement Fellings, but besides that the required leisure would have been wanting to deal with so large and important a branch of indigenous Indian Forestry I had to fix a limit to the already swollen proportions of the book".

† Working Plan for the Rehar and Garibalc and Forests, Naini Tal Division.

‡ Economics of Forestry, B. E. Fernow.

§ "By a sylvicultural system is understood the systematically arranged method according to which the formation, regeneration, tending, and utilization of the woods which compose a forest are affected" Schlich's Manual of Forestry, Vol. II.

the exploitable tree and the regeneration of the forest is to be brought about. The other school, on the other hand, looks upon improvement fellings merely as a transitory period during which the *existing* crop will be allowed to grow up and develop, this being merely assisted by judicious cultural operations, such as cleanings, thinnings, weedings and other improvement works (travaux d'amélioration); but the time for the reproduction of the forest, for the introduction of a recognised sylvicultural system has not yet come.*

Nevertheless, though considerable diversity of opinion exists, the fact remains that the method of "Improvement Fellings" has been accepted in Indian Forestry, if not as a regular "sylvicultural system," at all events as a method for the systematic regulation and treatment of irregular crops; and it is essential that the term be defined in a manner acceptable to all Foresters.

A careful study of existing Working Plans† will reveal the fact that, with the exception of a certain want of precision, and a harping around the question of natural seed or coppice regeneration fellings, considerable agreement appears to exist among Indian Foresters as to the definition of the term "Improvement Fellings" and the class of forest to which this method of treatment is applicable. It is only when the scheme of fellings comes to be elaborated that the irreconcilable differences above referred to become manifest. In existing working plans, the term "Improvement Fellings" has been defined as "systematic sylviculture" as "a preparatory period in order properly to constitute the growing stock"; as "the reconstitution of a partially ruined forest,' as an operation "to improve the stock": and as an "Improvement (Selection) system."‡ The forest to be so treated is described as

* This appears to be the view accepted by the Government of India, Revenue and Agricultural Department Circular No. 25 F., dated 13th August 1889, prescribes the term to be used in describing Fellings. These are divided into (i) Regeneration fellings, (ii) Amelioration fellings, and (iii) Unclassed fellings. Amelioration fellings are defined as fellings with the view of improving the condition of the existing crop, and these include Improvement Fellings.

† See Appendix giving a list of the principal forest areas systematically worked under the method of Improvement Fellings.

‡ Extracts from existing Working Plans, see Appendix.

'a degraded, overfelled irregular forest in which age classes of the more valuable tree species are very imperfectly represented; sound, mature, and second class stems being almost wholly absent from the crop, which as a whole has suffered greatly from the almost annually recurring fires"*. Or, again, in another place, 'the stems of the higher classes are all injured and unsound, reproduction is irregular, owing to variation in the period of protection and consequent variation in quality of soil, and also, doubtless, in places to the excessive density of the cover; there also is no regularity in the proportion of distribution of the age classes. The treatment proposed should be such as will as soon as possible overcome these irregularities and encourage sound and healthy growth in the future."†

In all this there exists a certain degree of unanimity; but in prescribing the fellings the different schools of forestry at once part company. The one school boldly prescribes the harvesting of the exploitable crop, the removal of all mature trees, and the carrying out of regeneration (preparatory, seed, and final) fellings. The removal of "all mature sal sound or otherwise, standing over young growth of that species."† "The removal of mature trees which, on account of their dense shade, either prevent the germination of seed or interfere with the growth of the young crop."‡

The other school restricts the fellings to cleanings, thinnings and weedings. "Improvement Fellings to consist purely of thinnings and weeding"§; "moderate thinnings and cleanings with supplementary operations, such as creeper-cutting and experimental planting, and the construction of such roads and buildings as are still required to make the forests completely and easily accessible'† "Fellings shall be restricted to purely sylvicultural requirements of the crop They will embrace only the unsound material; but no stem, however unsound, should be felled in areas where reproduction is wanting and the crop open."† "The improvement

* Working Plan of the Dubare Reserve, Coorg.

† Extracts from existing Working Plans, see Appendix.

‡ Motipur Working Plan, Oudh.

§ Rehar-Garibulehar Forests Working Plan, Naini Tal.

felling will consist in the removal of unsound stems where reproduction is sufficient, or where a sufficient number of young, sound trees renders their presence unnecessary; and in thinning and cleaning operations where patches of crowded growth exists."*

And, hovering between the two schools is the Forester either uncertain which master to follow, or following the one, whilst excusing his temerity. "It is not proposed to have special exploitation of mature trees, the removal of such trees depending entirely on sylvicultural requirements". "In improvement fellings the exploitable age is never fixed, except when mature trees are allowed to be removed."*

The clear-cutting system, the shelterwood compartment system, the group system, the selection system, the coppice or coppice with standards systems are the principal sylvicultural systems, or systematically arranged methods according to which the formation, regeneration, tending and utilisation of the woods which compose a forest are effected. Each of these systems has been defined and given a recognised place in forest terminology. With each of these systems supplementary regulations, cleanings, thinnings, weedings (that is "improvement fellings" or "coupes d'amélioration")—are prescribed, in addition to other works of improvement, (travaux d'amélioration). Consequently, whether the method of improvement fellings is to be recognised as a regular sylvicultural system or not, it cannot at all events be made to usurp the place already occupied by one of the accepted sylvicultural systems. When, therefore, as is often the case in India, the method of improvement fellings is prescribed as the principal and sole method of treatment, something different must be meant. It cannot be the removal of the exploitable or so-called mature tree, for this is the "selection method", and the thinnings and cleanings are then required to be entered as supplementary regulations, even though they may form the most important feature of the operations prescribed. This indeed is the view generally accepted in Burma, where in the mixed teak forests worked under the selection system, great stress is laid on the

* Extracts from existing Working Plans, see Appendix

regulation of the supplementary improvement fellings, operations of the highest importance. For similar reasons regeneration *fellings, (preparatory, seed or final fellings), must be vetoed* in order to prevent the improvement fellings from trespassing into the domain of the group, or shelterwood compartment systems. Analogically, eliminating all unsustainable interpretations, the conclusion must eventually be arrived at that only one definition of the term Improvement Fellings is possible, namely :—" By improvement fellings whether prescribed as supplementary regulations or as the principal method of treatment, are understood thinnings, cleanings and weedings, prescribed with the object of assisting *in the development and improvement* of the existing crop and the reconstitution of the forest capital."

Accepting this definition, the rules for fellings must conform to the regulations therein contained, however much the actual wording may in each case vary according to the particular conditions which may be found prevailing in the area to be dealt with. In a word, in prescribing the fellings the object in view must in every case be the same, namely, to foster and improve the existing *crop by judiciously executed weedings, cleanings, and thinnings,* and other works of improvement. Thus, " the object of improvement fellings shall be the removal of crooked or diseased wood in the crop not required for seed bearers."* Or, " the object in view shall be to restore the crop to its former condition by carefully executed improvement fellings bearing upon over-mature, injured and valueless stems, by favourising the spread of *high class timber* in suitable situations and above all by lessening the present causes of injury of which fire is the chief "*. Or again, the improvement fellings are prescribed for " the protection and favouring of the existing crop in the denser portions ; and the encouragement of all valuable forest growth in the open places " *; or with a view to " the improvement of the generally unsound crop the forest holds, so that when this has become more normal the most suitable method of working applicable can be determined without difficulty " * ; or " to favour the growth of the more valuable and better grown

* Extract from existing Working Plans see Appendix.

trees at the expense of their less valuable and less well-grown neighbours."*†

The possibility under the method of improvement fellings can only be fixed by areas or, to be more correct, the fellings must be regulated by area. The rest can only be left to the marking officer Consequently, "the marking officer must use his discretion regarding trees which are not shapely, sound, or thriving. He will take into consideration the conditions of the forest crop with which he has to deal and the short time to elapse before the next exploitation."* "The area check by itself will not prevent over-felling, and consequently the only safeguard will be in careful markings to be personally checked by a superior officer. The forest has been degraded by over felling the timber at present available is mostly of inferior quality; and consequently considerations of revenue must be of secondary importance."* "It must be borne in mind that the improvement of the forest capital, particularly in respect of large trees of the most valuable kinds, must not be sacrificed for the sake of immediate revenue."*

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* Extracts from existing Working Plans, see Appendix.

† The following set of sample felling rules may be submitted for criticism:—

(i) Inferior material interfering with superior shall be felled, girdled, or lopped, as may be most suitable.

(*Note* 1.—By "inferior material" is meant inferior by reason of its species or its growth, but this prescription must be intelligently applied, and the operator must use his judgment when dealing with well-grown trees of inferior species, suppressing a badly grown tree of superior species.

(*Note* 2.—This prescription may include the cutting back of bamboo culms for the release of existing seedlings of superior species.)

(ii) Congestion amongst groups of poles of valuable species shall be relieved.

(iii) All dead trees shall be removed if marketable.

(iv) Obviously over-mature trees, which cannot last to the end of the felling rotations, may be cut, provided seed bearers exist in the vicinity, even though not standing over young growth of the better species.

(*Note.*—Trees standing along the edges of banks and isolated trees shall not be felled even on the plea that they are badly grown, over-mature or of inferior species.)

(v) Irretrievably injured poles of superior species of a girth below 1½ feet at breast height shall be coppiced with the object of obtaining a better coppice regrowth.

(*Note.*—Strictly speaking, under the method of improvement fellings the above prescription requires to be justified.)

(vi) All creepers shall be cut in the coupe of the year.

(*Note.*—Climbers should as a rule be cut a year in advance of the regular fellings.)

(vii) None but a trained Ranger shall be permitted to carry out the markings, and it is absolutely necessary that the Divisional Officer himself shall exercise strict supervision over the work.

So far an endeavour has been made to define the method of improvement fellings as at present applied in India, so long as such application does not run counter to the accepted teachings of European schools. Thus, while discarding the possibility of prescribing under this method of treatment the removal of sound trees of the valuable species, the term has been taken to include the carrying out of cleanings, weedings and thinnings over defined areas. The fact cannot, however, be overlooked that even a more restricted definition of the term has been suggested, primarily by the late Mr. W. E. D'Arcy of the Indian Forest Service; and the suggestion has with a good show of reason undoubtedly received a fair amount of support. In the method of treatment, applicable to irregular and ruined forests which has above been described as the "Method of Improvement Fellings", the removal of the ill-grown or injured trees of the valuable species may be said to constitute the principal fellings; the thinnings and weedings, the supplementary operations, or "coupes d'amélioration". Such principal fellings should obviously be designated by some more convenient term, such as "Restoration Fellings"; the term Improvement Fellings then being restricted wholly and in every case to the recognised supplementary operations, that is to "coupes d'amélioration".

Gradually, as the resources at the disposal of the department increase, the forests will be brought under more intense and more carefully systematised working and the necessity for purely provisional cultural methods of treatment will pass away. Nevertheless whatever the sylvicultural system adopted, "coupes d'amélioration" and "travaux d'amélioration" will ever remain imperative supplementary operations. Moreover, the time appears to have arrived to so define the term "Improvement Felling" as to prevent its being misapplied and even perpetuated as a synonym for a debased selection system where the possibility is fixed by area.

C.

APPENDIX

Forests under Working Plans prescribing Improvement Fellings, from information supplied by Imperial Superintendent, Forest Working Plans, Dehra Dun U. P.

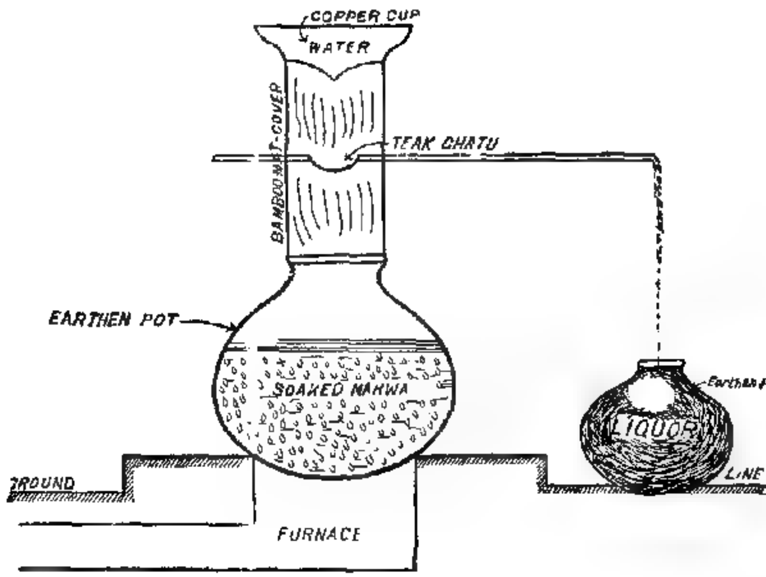
Province.	Working Plan.	Area in acres.
United Provinces ...	Bhinga Range	69,801
Ditto ...	Motipur Range ...	120,320
Ditto ...	Rehar, Garhibulchand, Makonia and Kilauli Forests.	39,040
Ditto ...	Pilibhit closed forests	45,440
Central Provinces ...	Paoni Range	25,555
Ditto ...	Bawa thari Range	47,784
Ditto ...	Lakhn Range ...	39,643
Ditto ...	Balod Range	96,887
Ditto ...	Penga ga Reserve	12,160
Ditto ...	East Pench Range	144,231
Ditto ...	Billar Ghugwa Reserve	1,606
Ditto ...	Saori and Ainsa Reserves	12,335
Ditto ...	Chita a dara Reserve	2,136
Ditto ...	Silliwa i Ghat Range ...	73,885
Ditto ...	Brahmapuri Range	61,068
Ditto ...	Arvi Range	109,613
Ditto ...	Korai Range	123,382
Ditto ...	Gangi ala Range	60,795
Ditto	Dhansua Range	55,000
Ditto ...	Pandrato a Reserve ...	5,328
Ditto ...	Gar jev al i Range	67,628
Ditto ...	Gaikhuri Range	93,067
Ditto ...	Sank Range ...	65,299
Ditto ...	Umreth Range	103,762
Ditto ...	Amarwara Range	56,824
Ditto ...	Moha l Range	114,27
Ditto ...	Sapna Khallari Range ...	88,582
Ditto ...	Pertab ?arh Range	84,375
Ditto ...	Bari Range ...	40,320
Ditto ...	Hoshangabad Forest Division ...	615,040
Ditto ...	Haveli Range	103,834
Ditto ...	Daam ar Range	113,613
Ditto ...	Barap har Range	50,215
Ditto ...	Waron Range	46,968
Ditto ...	Laua Range	151,675
Ditto ...	Ugl Range ...	62,512
Ditto ...	Lormi Range	281,460
Ditto ...	Jubbulpore Forest Division ...	332,160
Ditto ...	Baihar Range	126,914
Ditto ...	Paraswara Range	73,938
Ditto ...	Gnote Range	183,958
Ditto ...	Chapa a, Dhooma and Nerbudda Ranges...	231,887
Ditto ...	Amba Range	95,867
Punjab ...	Upper Ravi Forests	53,120
Bengal ...	Tista Valley Range	7,680
Ditto ...	Sunderbuns Government Forests ...	2,453,120
Coorg ...	Arkeri Forest	18,262
Ditto ...	Dubare Forests	11,363
Ditto ...	Devamachi Mawkal Forests	17,674

PREPARATION OF BHIL LIQUOR FROM MAHUA FLOWERS.

BY J. D. ST. JOSEPH, CHIEF FOREST OFFICER, MARWAR STATE.

FIRST METHOD.

Sixteen seers of *mahua* (flowers of *Bassia latifolia*) is steeped in water. In the case of old *mahua*, that is, of two years and over, the soaking lasts for 8 or 10 days, otherwise it is over in 4 or 5 days. The soaked substance is then placed in a large earthen chatty and



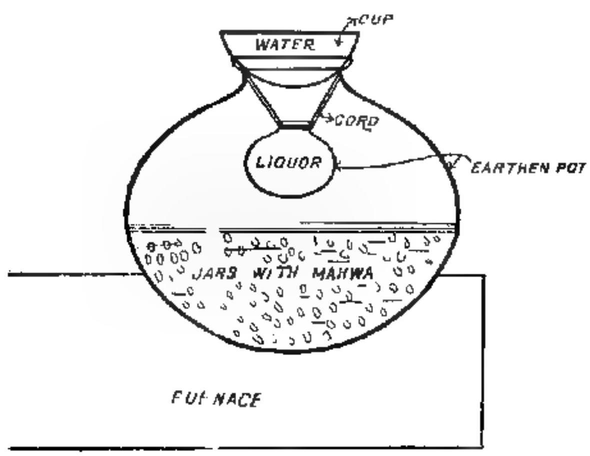
water poured in till it tops the *mahua* by 2 or 3 inches; this renders the chatty about half full and prevents overflow when boiling. A bamboo mat called "*Pergalee*" made in the form of a cylinder about 1¼ feet high and daubed with clay is fitted closely on to the mouth of the chatty, the joint being well plastered with clay. A copper cup with a projecting bottom called "*Batla*" is placed over the opening at the top of the mat cylinder or *Pergalee*—(see sketch)—and firmly fixed with mud plaster. A discharging pipe of teakwood called "*Chatu*" is thrust through the mat cylinder about the middle; the part immediately below the bottom of the cup or "*Batla*" is scooped out like a ladle 1½ inch to 2 inches in diameter, the piping being of ¼ to ½ inch

diameter. A small chatty is placed below the end of the discharge pipe The copper cup is kept supplied with cold water. During the boiling process the steam rises and, condensing against the cold surface of the cup, trickles into the ladle in the retort from which it is discharged through the pipe into the vessel outside

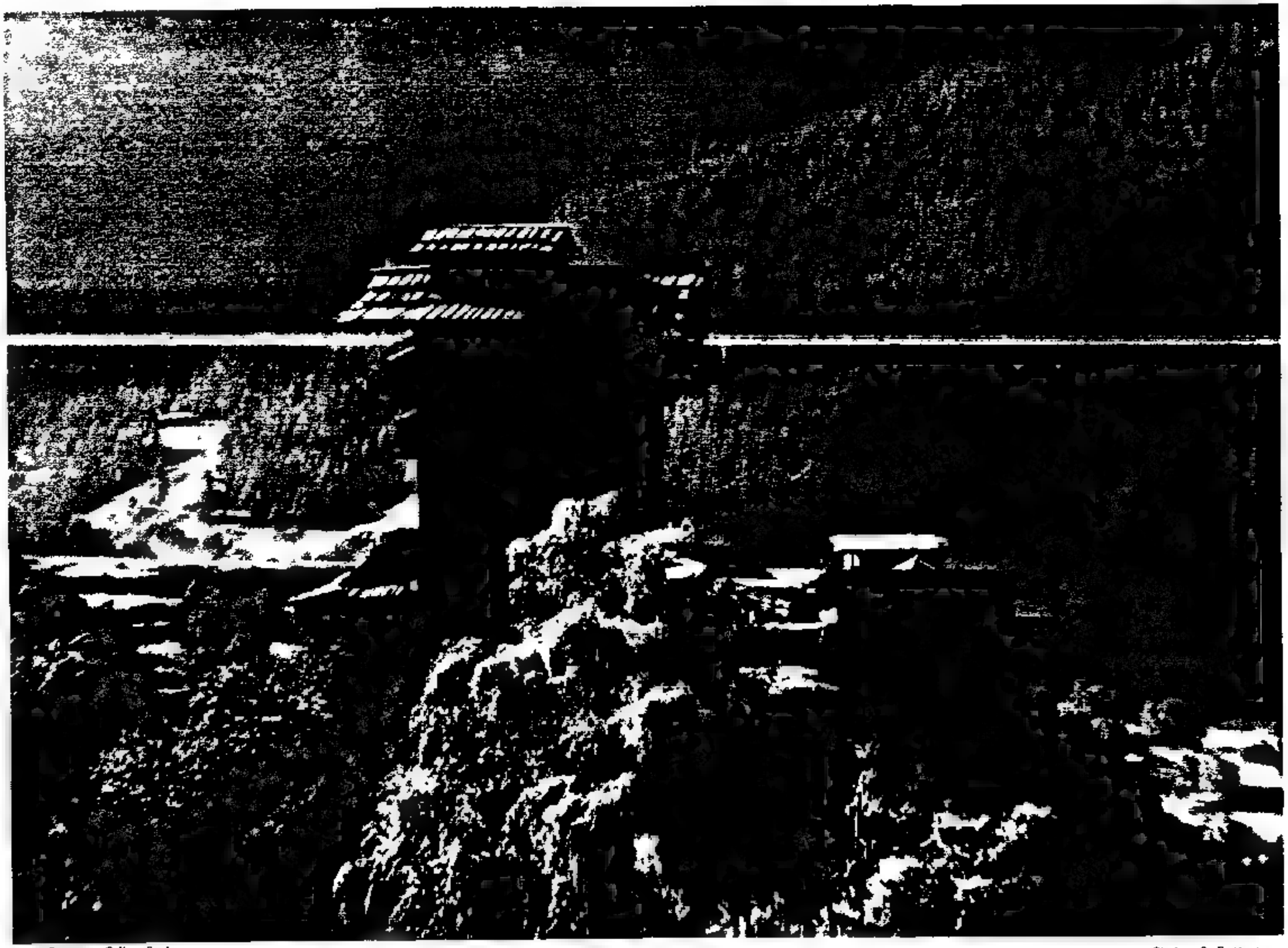
The process takes about 3 hours and 8 ordinary sized bottles of liquor are obtained from the quantity mentioned. The liquor is considered to have cooling properties and is not so intoxicating as ordinary distilled liquor. The implements used in the manufacture last a long time.

SECOND METHOD.

A few seers of *mahua* is well boiled in an earthen vessel. The water known as *Ras* is then strained off and kept for 3 or 4 days until it ferments. It is then poured into a large vessel and 6 to 8 seers of *mahua* added. A small earthen pot is now hung



by means of a cord inside the large vessel in such manner that the bottom remains about 6 inches above the boiling fluid. A copper or brass cup containing cold water is placed over the mouth of the chatty, the joint being well plastered with clay. The water in the cup is changed when it becomes tepid. During the boiling process, the steam condenses against the cold surface of the cup and trickles into the pot hung inside. The Bhils know through



Bemrose, Collo., Derby Photo. G. S. Hart

OLD FORT, KAMRU STATE, N.W. HIMALAYAS.

experience when the pot fills, it is then removed and about a bottle of liquor obtained.

The liquor obtained by this process is called *Thakia* and is said to have cooling properties and does not cause giddiness or produce vomiting if drunk in excess.

LAND-PRESERVATION IN THE PUNJAB.

BY RANGER GURAN DITTA MAL.

In the May number of the *Indian Forester* there is a small note about the good progress which is being made by the Punjab Local Government in the land preservation (chos) in the Punjab. No doubt in the Hoshiarpur district excellent work is being done by the Government, although the people think it a great hardship and do not realise the good results that will follow. All those bare slopes, which gave birth to those dreadful *chos*, have been or are being made Reserves and the rights of the people therein are being compounded. There is every probability that good results will follow and all the remaining valuable cultivation will escape the calamity.

The attention of Government has not yet been drawn towards the hills of the Jhelum district. In the Jhelum district there is a long series of small hills running almost north east to south-west and parallel to the river. Between the hill series and the Jhelum river there are large tracts of valuable and fertile fields. Now year after year these valuable fields are being encroached upon by the sand brought down from those hills by the ravines locally called *kas*. The writer being an inhabitant of that locality can say that these *kas* are increasing in dimensions year by year. Between Jhelum town and Sanghoi village, a distance of 9 miles only, there are 5 or 6 such *kas*, one of them being about 1½ miles in breadth (this one is specially called *kahan* and is at a distance of 3 miles only from Jhelum). All these *kas* bring down every rains an immense quantity of sand on to the cultivation. During the last 10 years between Jhelum and Sanghoi two new *kas* have been added to the list and I cannot say what has happened lower down.

In last February the big *kahan* leaving its direct course turned its attention to the cultivation of the villages Naugran, Kot and Aryala and covered all those valuable fields with sand, creating also a new *kas* near the village Naugran.

During last winter the writer had a chance of visiting those hills on a shikar excursion and was astonished to see the devastation being done therein. All the hills are absolutely bare or nearly so. They consist of almost pure loose sandstone and there being very little vegetation on the ground, there is nothing to prevent the water carrying with it the sand on its downward journey towards the Jhelum river

There are none of the executive difficulties in the way as was the case in the Hoshiarpur district, as all these hill tracts are already Reserves and as far as I know the people have got very few rights in them. Therefore I trust that the Government may turn its kind attention towards these tracts and try to restock the hills so as to save the poor inhabitants from the calamity which is staring them in the face.

The Forest Department should make efforts to create plantations all along the hills. In addition to their saving the low-lying cultivation they will constitute a paying property to the Government.

ology we can recommend its perusal as a most fascinating recreation.

SHIKAR, TRAVEL AND NATURAL HISTORY NOTES.

THE IBEX OF CENTRAL ASIA.

BY W. S. BURKE, EDITOR, THE INDIAN FIELD.

For some at least of the older naturalists an ibex was an ibex whether it came from the Himalayas or from the Alps, and it is therefore not surprising to find Brian Hodgson in his earlier days alluding to the ibex of the Himalayas as *Capra ibex*, or, in other words, as inseparable from the steinbok, or ibex, of the Alps. It happened, however, that long before his time a German naturalist, Meyer by name, had recognised the specific distinctness of the

ibex of Central Asia from its Alpine cousin, and in 1794 he proposed for the former the name of *Capra sibirica.*

Forty-six years later Edward Blyth proposed the title of *Capra sakeen* for the Himalayan ibex, the name being derived from the Ladaki designation *skin, iskin* or *sakin.*

That the Central Asian ibex, as a whole, is widely different from its smaller European relative is abundantly clear; so evident indeed is this that it will be quite unnecessary to point out in this place the distinctive characteristics of the two species. It is further evident that all the ibex of Central Asia—from Afghanistan and the Altai in the west to the Thian Shan and Ladak in the east—are referable to a single species, Meyer's *Capra sibirica.* In the case of a species having such an enormous geographical range, and with several of its local representatives more or less completely isolated from one another, it is, however, only natural to expect that great variation would be met with; and as a matter of fact such is actually the case. The recognition of such local races of the Asiatic ibex has been a slow matter, and perhaps all are not yet described, although, on the other hand, some of those which have been named are not really entitled to racial separation.

The late Dr. W. T. Blanford, who was very conservative in such matters, refused to recognize any definite local races of the species contenting himself, in the *Fauna of British India,* with the following remarks:—"A very dark-coloured ibex is said to occur in Baltistan, but is, according to Skully, merely the old mate in winter vesture. Ibex from Siberia and from the Thian Shan mountains north of Kashgar have the abdomen and the back of the carpus and tarsus [fore and hind cannon-bones] white, contrasting strongly with the front of the legs, which is very dark brown. Colonel J. Biddulph, to whom I am indebted for calling my attention to this character, is of opinion that the Thian Shan animal is the true *Capra sibirica* and the Himalayan one distinct, in which case the latter would take the name of *Capra sakin.*

"Mr. R. A. Sterndale has described the head of an ibex purchased in Kashmir . . . In section the horns resemble those

of *C. sibirica* The horns are 52 inches long, dark coloured, and remarkably curved round, much more than in ordinary *C. sibirica*; there are no knobs except near the tips. Three specimens are recorded and it is suggested they may come from the country West of Kashmir. Mr. Sterndale proposed to call this wild goat *Capra dauvergnei* if new'

In 1900 Mr. Lydekker proposed the name of *Capra sibirica wardi* for the above mentioned dark-coloured ibex from Baltistan, while in the same year the Hon'ble Walter Rothschild bestowed the title of *C. sibirica lydekkeri* on the ibex of the Katutay range of the Irtish Altai. Subsequently Mr. Lydekker clearly defined and figured the Himalayan ibex *C. sibirica sakin*, while still later other writers have named additional races. Quite recently Dr. Lorenz von Libarnau, who has visited some of the principal museums of Europe with the object of specially studying Central Asian ibex, has published in one of the serials of the Vienne Academy a review of all that is known on the subject, with the description of yet other new races This paper is of such importance that a brief *résumé* cannot fail to be of interest to sportsmen in India

As is usual when we have to deal with a large number of local races, a difficulty crops up with regard to English names For the species in general the proper title is the Asiatic or Siberian ibex; and the various sub-species ought to be known as such and such races of that species The *Capra sibirica wardi* should, for instance, be called the Baltistan race of the Asiatic ibex. This is, however, somewhat cumbersome, and it is consequently generally known as the Baltistan ibex. On the other hand, this makes it appear as a distinct species. A way out of the difficulty would be to call the Asiatic ibex the skin (= skeen), or sakin, and we should then have the Baltistan sakin, the Katutay sakin, etc., which would make everything quite plain and simple.

Contrary to the opinion of Messrs. Biddulph and Blanford, the typical *Capra sibirica* according to Dr. Von Lorenz, is from the northern slope of the Sayansk range, in the neighbourhood of Munku Sardyk to the eastward of Lake Baikal This Sayansk

ibex, or sakin, is therefore *Capra sibirica typica*. In colour the whole of the upper parts are dirty yellowish white tending to a purer white on the middle of the back: on the belly the hairs are brown, with bluish tips; but the forehead, a ring round each eye, the occiput, the ears, and the sides of the neck are darker There is a small white line on the upper and a larger one on the lower lip. There is a narrow dark dorsal stripe, and also an indistinct shoulder-stripe. The hind legs are brown in front and whitish on the outer side inferiorly, and there is some white on the hinder side of the forefoot near the lateral hoops. Old bucks sometimes become almost wholly white. The absence of a distinct white saddle is characteristic of this race.

The ibex from the district known to Germans as the Bia Altai, in the neighbourhood of Lake Telezko (neither marked in the *Times Atlas*) has been named *C. sibirica fasciata*. It is said to be yellowish brown above, with a dark spot on the lower lip at the angle of the mouth, and a broad horizontal black band on the lower part of the foreleg; there is a light patch on the hinder surface of the lower portion of the hindleg, and a distinct whorl of hair on the outer side of the same; the ears are large and rounded, lighter inside than out; and the eyes are brownish red, instead of yellowish grey, as in the next race.

The Irtish sakin, *C. sibirica altaica*, is said to be wholly greyish brown in the summer coat, without a white saddle or neck patch. In the latter respect it seems to agree with the typical race, from which it differs somewhat in bodily form, the shape of the horns, and colour; *café au lait* brown is said to be its general colour with a dark dorsal stripe. The horns are light-coloured, and strongly curved at tips. This ibex occurs at Tarbagatai. In the Katutay ibex, or sakin, *C. sibirica lydekkeri* of the Katutay range of the Irtish Altai, the general colour is umber brown, slightly lighter than that of the Thian Shan race in winter, with the face forehead, neck patch, a dorsal saddle, and the hinder side of the lower part of the legs dirty or creamy white. The light saddle is intermediate in size between that of the Thian Shan and that of the Baltistan race and is much expanded in the middle

over the flanks. The horns are extraordinarily massive, with very large knots.

The Kobdo ibex, *C. sibirica hagenbecki*, appears to be widely distributed in Northern Mongolia, and is of a pale breadcrust brown colour, without a light saddle, and specially characterised by the presence of a callosity on the knee-joint. The horns have a curvature similar to those of the typical race, but the knots in the middle are larger and more approximated; while there are also differences in their contour.

The Thian Shan ibex, which ranges southward to Lake Issik Kul and Kuldja is named *C. sibirica almasyi*; it is represented in the British Museum by specimens killed at Kuldja by Messrs. Van der Byl and Littledale. It is lighter coloured than *C. sibirica lydekkeri*, with a broader white saddle and much larger horns, which display several peculiarities.

The ibex of the Central Thian Shan, in the neighbourhood of Naryn, has been separated as *C. sibirica merzbacheri*. It is said to differ from the last by the lighter colour of the dark areas, the more distinctly defined dorsal saddle, and the much shorter more divergent, and more heavily knotted horns.

More information is required with regard to the ibex of Tashkent and the Kara-kul, for the former of which the name of *C. sibirica aliana* and for the latter that of *C. sibirica transaliana* have been proposed. The former is said to be rufous in winter, and in summer to lack the white saddle; but both these features are probably based on error, as rufous is the summer and grey the winter tint of all these ibex. Probably the two are identical; if they indicate a distinct race, the former name stands.

The Baltistan ibex, *C. sibirica wardi*, is a well-defined race, characterised by its dark colour, and the large white saddle, separated only by a narrow dark band from the white neck-patch. In point of size the saddle is in fact intermediate between the relatively small one of *C. sibirica lydekkeri* and the very large one of *C. sibirica sacin*. The horns are not unlike those of the Thian Shan race but stouter, shorter, and narrower in transverse section.

As to *C. sibirica daubergnei*, of which the horns have been already mentioned, it is impossible to say anything definite at present. The horns are dark-coloured.

The Himalayan ibex *C. sibirica sacin*, as represented by a male in winter coat from the Zoji-lal (between Kashmir and Dras), is characterised by the whole back and the hinder part of the back of the neck being light brownish white, with only a narrow light brown dorsal stripe, becoming darker and broader near the tail. There is a narrow light greyish brown band along each flank; the shoulders and thighs are a darker brown; the under-parts are deep golden brown with a brown spot on the hinder side of the hind-foot above the hoof; and the head is brownish The horns are relatively slender

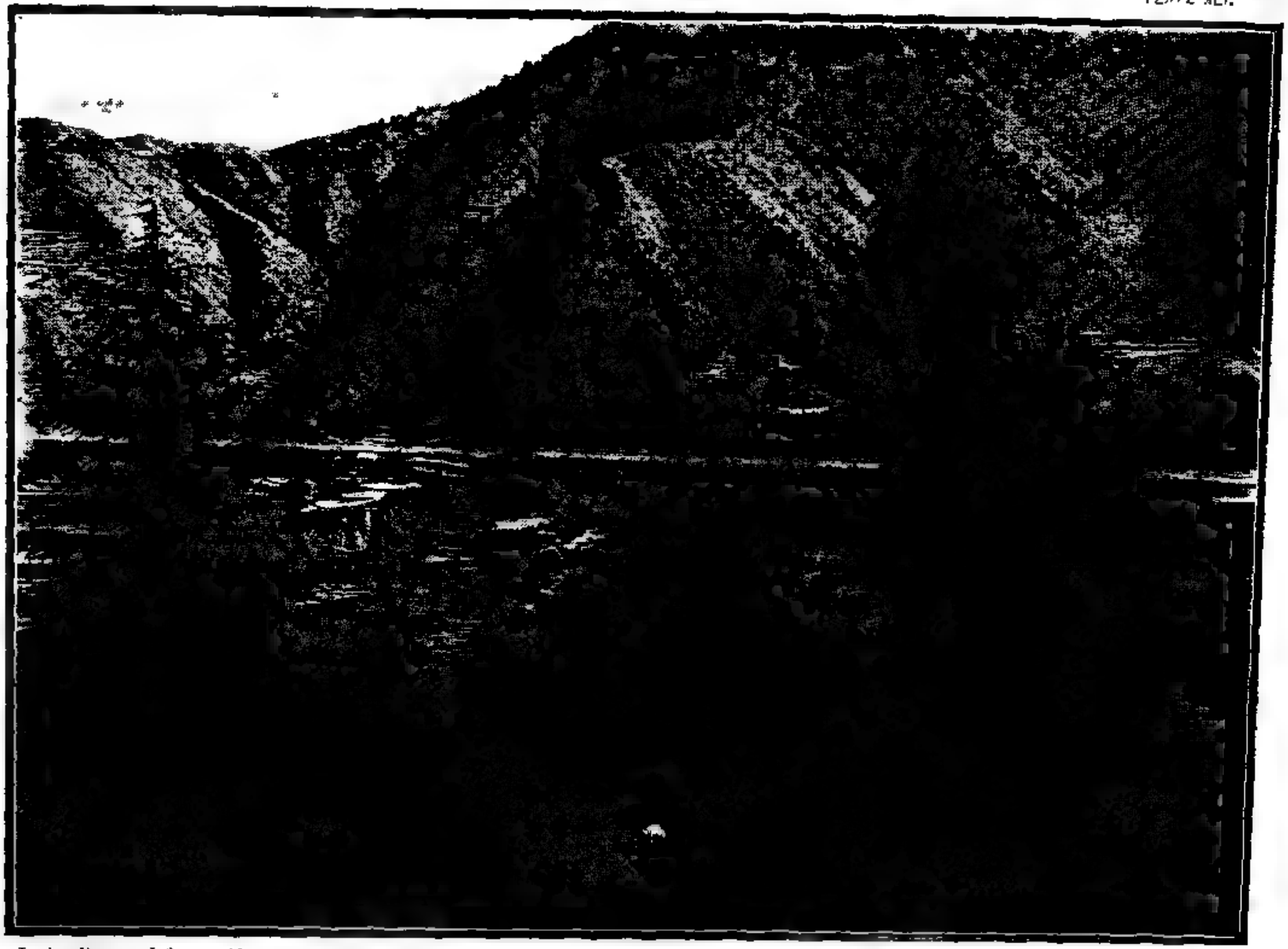
The Ladak ibex cannot, for want of sufficient material, be at present determined.

For the Gilgit ibex, which has very slender horns, Dr. von Lorenz proposes the provisional name of *C. sibirica pedri*, after Prince Pedro of Orleans, but it cannot yet be defined.

The Afghan and Chitral ibex, which (as represented by a male from Chitral in the summer coat) has no distinct light saddle, and small and slender light-coloured horns, Dr. von Lorenz considers it will probably be found to represent yet another race. It may be suggested, however, that (at all events so far as the Chitral animal is concerned) it is not really distinct from the Gilgit race.

Of the ibex found in Northern Sikkim and to the north of Lhasa nothing definite is known, and skins are much wanted.

The foregoing sketch, if it serves no other purpose, will at least enable sportsmen to understand the chief deficiencies in our knowledge of the ibex of Central Asia. —*The Indian Field.*



Eardley Wilmot—Influence of Forests

DENUDATION OF HILL SLOPES ABOVE CULTIVATION

VOLUME XXXII. NUMBER 12

INDIAN FORESTER

DECEMBER, 1906.

SELECTION BY AREA.

The article which appeared under this title in the April number of the Magazine* has evoked a certain amount of interesting criticism. Mr. Hobart Hampden describes a method of calculating the outturn of a forest on which a certain working-plan is based by a method which he terms "selection by area." He claimed for this method that it does not rest on so many assumptions as is the case with the selection method usually adapted in Indian forests; that such assumptions as it does make use of can be easily corrected at short intervals, and that even if its single aim (an approximate equal annual outturn) is not, after all, achieved, the error is of no great importance while sylvicultural errors (from which it is free) are very much so.

Mr. Lovegrove† considers that the allocation of the II class trees is wrong; he calculates that under Mr. Hobart-Hampden's plan, the Working-plans Officer will be out by so many trees, II class at the time of enumeration, as do not become I class by the year in which the coupe is worked.

Mr. Perrée† points out that in the case of the working-plan instanced by Mr. Hobart Hampden the yield has actually been

* Page 186 in this volume. | † *Ibid*, pp. 350 and 352

fixed by volume (number of stems), and that the question of area only comes in when it is necessary to balance, with more than ordinary accuracy, the year's outturn The possibility is based on a complete enumeration of three higher classes, and beyond the usual provision to work over the whole forest in a certain period the plan practically rests on volume. It is immaterial, he says, whether our unit is a I class stem or cubic foot, the stem check actually defines a fixed quantity of material and therefore is a volume check. "The particular virtue of the system is wholly dependent on the minuteness of enumeration," says Mr. Perrée, "but the assessment of yield by a simple method of proportion is surely not new."

We would wish here to consider the subject a little further. The whole crux of the thing is that Mr. Hobart-Hampden objects to the felling of II class stems, although this is usually prescribed in order that, in a selection area over the whole of which it is impossible to work *each* year, the full outturn of the area may be utilized instead of being allowed to accumulate. His method requires a "localised" complete enumeration of the first three age or growth classes and a "yearly" definition of the coupe. To justify such an enumeration a full staff and a valuable outturn are required. Further a complete scheme of communications is essential. Roads, railways and tramways cannot be laid out till the felling areas are prescribed in advance for a long period In the cases where this latter has been possible the Department has induced railway construction and obtained funds for large road and tramway construction.

Coming now to the financial aspect. To fell nothing but stems of the prescribed girth we must have coupes rapidly diminishing in area from No. 1 onwards, as the trees of the II class enter the higher class. Incidentally, it may be mentioned, in a permanent High Forest treatment by the method of selection, it is convenient to have permanent coupe boundaries and not to change them in each felling cycle. This by the way. Now if one has a large coupe No. 1 which will not be revisited for 30 years, surely it is necessary to include also a large number of II

class trees, many of which will be over-mature when you return, although you may try, in locating the coupe, to take advantage of the condition of the forest. In the 30th coupe you will have no II class trees save those which have passed from the III class during the cycle It is a mathematical problem whether it is not best financially to lay down permanent coupes of approximately equal value and include in your yield a rapidly diminishing number of II class trees, as is done at present, or leave a vast number of such trees to become over-mature as is suggested by Mr. Hobart-Hampden.

Of the practical convenience of our present plan there can be no two opinions, and we believe also that, in the majority of cases, it is financially sound.

In special cases where it is desired to raise the felling girth and where therefore the prescribed details for the coming felling period are dissimilar to those which would be laid down when the forest had arrived at the condition we desire, Mr. Hobart-Hampden's method might perhaps be useful in application, but as a question of universal practise we have grave doubts as to the novelty or suitability of the new departure.

SCIENTIFIC PAPERS.

THE SPRUCE OF SIKKIM AND THE CHUMBI VALLEY.

BY SIR DIETRICH BRANDIS, K.C.I.E., F.R.S.

Hooker, in his Himalayan Journals II, 32, 45, mentions a spruce in the Lachen valley of Sikkim at an elevation of 8,000 feet (*Seh*, Sikk.) which he calls *Abies Smithiana* (*Picea Morinda*, Link). Gamble in *Indian Timbers*, 717, mentions a specimen sent by Dr. Schlich from the Chumbi valley in Tibet, which he thinks is probably an undescribed species; he adds that the structure of the wood is identical with that of *Morinda*.

In Bhutan Griffith (1838) found a spruce between 8,000 and 10,000 feet, which he called *Abies spinulosa* in Journals 259 and Itinerary Notes 145, and which he figured in Ic. Pl. As. t 363 under the name of *Pinus spinulosa*.

In Indian Trees, 693, I had mentioned the Sikkim and Bhutan spruce under *Picea Morinda*. Subsequently Dr Augustine Henry drew my attention to the structure of the needles and suggested that the spruce of the Eastern Himalaya might be *Picea morindoides*, Rehder (Sargent, *Trees and Shrubs*, I 95, t 48). This species has been described from a tree cultivated at Angers in France, the origin of which is not known. The chief character consists in the shape and structure of the needles In regard to this point, the species of *Picea* may be divided into two sections.

That section to which *Picea excelsa*, the common European spruce, belongs has the transverse section of the needle rhomboid, with stomata on all four sides, the vertical diameter of the transverse section being always greater than half the horizontal diameter. Indeed in many cases the leaves of suppressed trees or of branches in the lower part of the crown are laterally compressed, so that the vertical is much longer than the horizontal diameter. To this section belongs the spruce of the Western Himalaya, *Picea Morinda*.

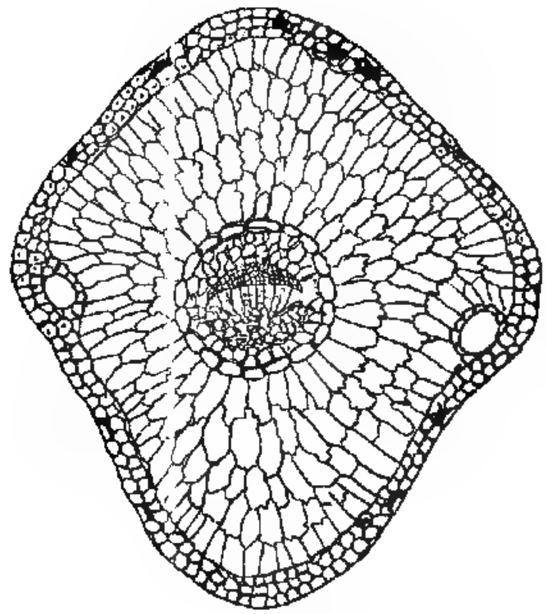
The leaves of the second section are more or less flat with stomata as a rule only on the upper side and the vertical much shorter than the horizontal diameter. To this section belong *Picea Omorika*, Pancić, the spruce of Servia, Bosnia and Montenegro, *Picea morindoides* Rehder, and the spruce of Sikkim and the Chumbi valley. Whether the spruce found by Griffith in Bhutan belongs to this section has not yet been settled. The structure of needles collected by Hooker in the Lachen valley agrees with that of the Chumbi tree.

The presence or absence of resin canals is not a reliable character in many species of *Picea*. *P. excelsa* has usually two resin canals, but needles with none or only one are not uncommon. In *P. Morinda* of the North-West Himalaya I always find two, while a specimen grown at Kew has only one.

The Chumbi spruce here figured has none, while some specimens collected by Hooker in the Lachen valley have two resin canals. Finally *P. Omorika* from Servia has two, while a specimen cultivated at Kew has no resin canals.

Brandis.

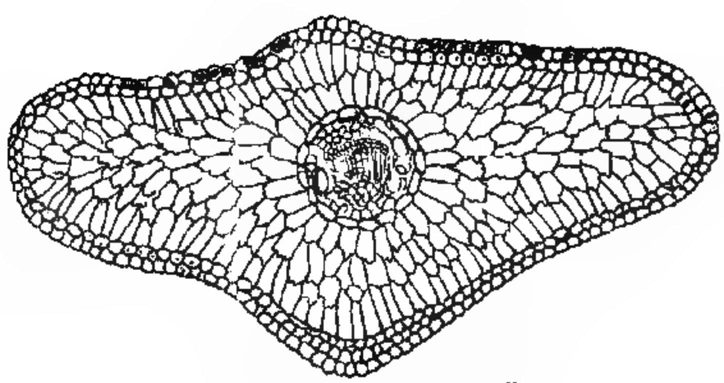
Fig. I.



Picea Morinda, Link.

$\frac{75}{1}$

Fig. 2.



The Spruce of the Chumli valley

$\frac{75}{1}$

J. N. F. del.

The specimens which I have been able to examine do not justify my giving the specific character of the spruce of Sikkim and Chumbi. Foresters in the Eastern Himalaya may have opportunities of studying the morphological and biological characters of this tree and perhaps also of that found by Griffith in Bhutan.

The figures which accompany this note (1, *P. Morinda*, 2, The Spruce of the Chumbi Valley) represent transverse sections of the needles and will explain themselves.

Kew, November 1906.

ORIGINAL ARTICLES.

PTEROCARPUS DALBERGIOIDES.

BY F. H. TODD, I.F.S

The forests of the North Andaman Island contain many important timber trees, the most valuable of which is the *Pterocarpus dalbergioides* (locally called "*Padauk*"), a species of *Pterocarpus* only found in the Andamans.

1. *Distribution and area.*—The area of the North Andaman Island is roughly 510 square miles, but only about a third of this is productive of Padauk; the rest is covered with mangrove swamps and evergreen forest.

As a general rule these classes of forest are distributed as follows :—

On the flat ground, close to the sea-shore, there is usually a belt of mangrove or littoral evergreen forest, which may extend from a few yards to a mile or more in width, beyond this belt, on the lower spurs and undulating ground, is found the Padauk-bearing forest which varies considerably in width, but may be said to vary in inverse proportion to the slope, as Padauk is not generally found at a greater elevation than 300 feet above sea level. Above the Padauk-bearing belt dense evergreen forest occurs covering the tops of the higher spurs and hills.

It is difficult to say why Padauk does not grow at a greater elevation than about 300 feet; the underlying rock shows little variation in any part of the North Andaman, and therefore

cannot be an important factor nor can the depth of soil have much influence, as Padauk is usually found not on the flat ground where the soil is deep but on well-drained hillsides where the soil is often very shallow. Whilst Padauk is found growing on the flat ground, the finest trees are invariably found on well-drained sheltered slopes.

Altitude, too, need not be considered, as the difference in temperature at sea level and 300 feet is hardly perceptible.

It seems probable that the aspect is the important factor since all those areas along the coast, which are in any way exposed to the full force of the south-west monsoon, are usually covered with dense evergreen forest unproductive of Padauk; rich Padauk-bearing forest being often found a short distance inland behind the shelter of this evergreen belt. In sheltered valleys also Padauk grows at a greater altitude than in exposed localities, in fact, it is very rare to find Padauk at all on exposed aspects, whatever the altitude may be.

2. *Description of Padauk bearing forests.*—There are two more or less distinct types of Padauk-bearing forest, which may be described as semi-evergreen and deciduous. On hot southern aspects Padauk is found growing with deciduous species only, such as *Bombax insigne, Sterculia sp., Terminalia sp., Artocarpus sp.*, etc.; while on cool northern aspects or on low badly drained plateaux a certain number of evergreen species, such as *Lagerstroemia hypoleuca, Mesua ferrea, Careya arborea, Dipterocarpus lævis* (var.), etc., will be found associated with the Padauk and the other deciduous species mentioned above.

Padauk is the predominant species in both types of forest, and averages about two first class trees* per acre.

The overhead canopy is usually very incomplete, and it is rare to find more than 12 trees of all species over 4½ feet in girth per acre.

The undergrowth in the deciduous forests is fairly light, and consists mostly of thorny creepers and the advance growth of the trees forming the high forest, with here and there prickly shrubs

* Trees which have a girth of over 7½ feet measured at 4½ feet from the ground.

(*Euphorbia sp.*). In the semi-evergreen forests the undergrowth is somewhat denser, and consists largely of scandent bamboo (*Dinochloa andamanica*) and canes (*Calamus sp.*), and in some localities of pure bamboo forest (*Oxytenanthera nigrociliata*).

3. *Influence of locality on girth and height growth.* Padauk grows best on well-drained sheltered slopes, especially if the soil happens to be a coarse rubbly sandy loam. In such localities Padauk will have a magnificent height growth and attain a girth of 17 or 18 feet, with a clean cylindrical bole for 40 50 feet.

On low flat badly drained country, Padauk has a fairly good girth and height growth, but usually produces very large "buttresses" and is often unsound.

In the North Andaman there are several very dry tracts which are practically waterless from December to June and which are covered with a very open deciduous forest. Here the Padauk is found to be somewhat stunted and rarely attains a girth of more than 9 feet.

4. *Natural regeneration.*—Considering the over-mature condition of the crop due to the forest never having been worked, and the probability that only a certain proportion of the seed produced is fertile, the natural regeneration of Padauk may be considered to be fairly good. The density of the undergrowth and the similarity of young Padauk seedlings to those of certain other species makes it very difficult to distinguish Padauk seedlings, but it has been noticed, wherever the undergrowth is comparatively light, that the natural regeneration is distinctly good, and considering how numerous Padauk saplings and poles are in the semi evergreen forests in which the undergrowth is fairly heavy, it may be presumed that Padauk natural regeneration is fairly satisfactory over the whole Padauk-bearing area

The natural regeneration of Padauk is influenced to a very slight extent by the shade of the overhead canopy which, as stated above, is usually very incomplete; more depends on the type of undergrowth, whether natural regeneration is successful or not.

The type of undergrowth which appears mostly to hinder the natural regeneration of Padauk is a mass of canes, scandent bamboo

and other creepers; if any Padauk seed happens to germinate among such undergrowth, the seedling is soon covered with creepers and suppressed. On the other hand, Padauk seedlings seem to be able to stand a comparatively heavy shade as long as the canopy causing the shade is at some height from the ground; for instance, in bamboo forest, where there is usually little or no other undergrowth, Padauk saplings are often found growing quite vigorously in spite of the heavy canopy 20—30 feet above them.

For the first two or three years of its life a Padauk seedling suffers from attacks of caterpillars, these pests strip it almost entirely of leaves and retard its growth considerably. Once the seedling reaches a height of 4 or 5 feet, it appears to become immune to these attacks.

5. *Rate of growth.*—As it is very doubtful whether Padauk has true annual rings or not, the rate of growth has been calculated roughly as follows: —

On the east coast of the North Andaman, in Port Cornwallis, is situated Chatham Island which was cleared of jungle in 1792 in order to establish a settlement; it was, however, abandoned in 1796; thus the Padauk trees at present growing on the island must all be under 110 years old; but to be on the safe side it has been assumed in the following calculation that they are all exactly 110 years old: —

The girths of 50 Padauk trees were carefully measured and the average was found to be 6 feet 1 inch, which gives an annual girth increment of ·66 of an inch. As these trees, however, have grown up under rather favourable conditions, ·6 of an inch is assumed to be the mean average annual girth increment. Allowing 10 years for a seedling to establish itself, it is estimated that

a Padauk tree 3′ in girth is 60 + 10 = 70 years old.
" " 6′ " " 130 " "
" " 7′ " " 150 " "

The rate of growth is very much more rapid when the Padauk is artificially planted, as many of the trees in the 1885 plantation at Port Blair are over 2 feet in girth, and some in the 1883 plantation 2½ feet in girth.

6. *Injuries to which the Padauk forest is liable.*—The chief cause of injury is wind: not the ordinary monsoon wind, but cyclones. The damage done by the latter is very serious and the effect is quite noticeable many years after the occurrence. For instance, along the track of the cyclone, which visited the North Andaman in 1893, there is now nothing but an impenetrable mass of canes, scandent bamboo, and creepers of all sorts in which it is impossible for a Padauk seedling to establish itself.

The dense masses of creepers and scandent bamboo (*D. andamanica*) in the semi evergreen forests are such that little or no natural regeneration is possible.

Ficus-bound trees are not so common as might be expected in these moist forests, though a certain number of Padauk trees in the semi-evergreen forests were found to be attacked.

Fire does very little damage, as only a small portion of the North Andaman forests is dry enough to burn.

7. *Description of the timber.*—The following description of the timber of Padauk is taken from an advertisement issued by the Forest Office, Port Blair

"PADAUK (*Pterocarpus dalbergioides*, R.)—Colour, pale red to rich bright red deepening on exposure, or dark brown. Weight per cubic foot 40 to 60 lbs (dry), 60 to 80 lbs. (green).* Seasons quickly and easily.

Heart wood immune to attacks of white-ants and borers, except the marine worm and to all kinds of rot.

Sap-wood, white, liable to attacks of borers and to rapid decay through dry rot. Squares usually up to 20 feet in length; siding up to 2 feet.

Uses:—Posts, beams, planks and shingles in house building; and for keel, stem and stern posts, knees and other parts of boats. Makes handsome furniture, panels, parquet flooring, and carving, taking a beautiful polish. Is used for frame-work of organs, pianofortes and billiard tables; frame-work of buggies and gun-carriages; parts of machines and implements; fittings of railway

* Over 9[illegible] per cent of the green logs extracted from the Andaman forests will float in sea water.—F. H. T.

carriages, ships' saloons and tramcars, and is generally suitable for all purposes to which teak, mahogany, hickory, oak, and ash are applied."

All Padauk, however is not "pale red to rich bright red" in colour; not infrequently the timber is found to be of a light reddish brown and is in consequence of considerably less value. It is difficult to say what percentage of the logs extracted from the Andaman forests is of this inferior colour, but 10 per cent may be taken as an approximate estimate.

The reason for the difference in colour of trees growing together is not fully understood, but considering that trees of exceptionally large girth and the timber of all windfalls, stumps, and dead standing trees are generally of the richer colour it would appear to be that the timber becomes redder in colour the nearer a Padauk tree approaches maturity, or, which is still more probable, death.

It is possible that the girdling of Padauk two or three years before it is felled would have a favourable effect on the colour of the timber.

8. The following are some of the more important timber trees found growing with the Padauk :—

Local name.	Botanical name.
Koko.	Albizzia Lebbek.
Pyinma.	Lagerströmia hypoleuca.
Gurjan.	Dipterocarpus sp.
Didu.	Bombax insigne.
White Chuglam.	Terminalia bialata.
Black	Myristica Irya.
Marble or Zebra-wood.	Diospyros Kurzii.
Bambwè.	Careya arborea.
Chooi.	Alphonsea ventricosa.
Lakuch.	Artocarpus Lakoocha.
Gangaw.	Mesua ferrea
Thingan.	Hopea odorata.
Taungpein.	Artocarpus Chaplasha.
Ywegyi.	Adenanthera pavonina.

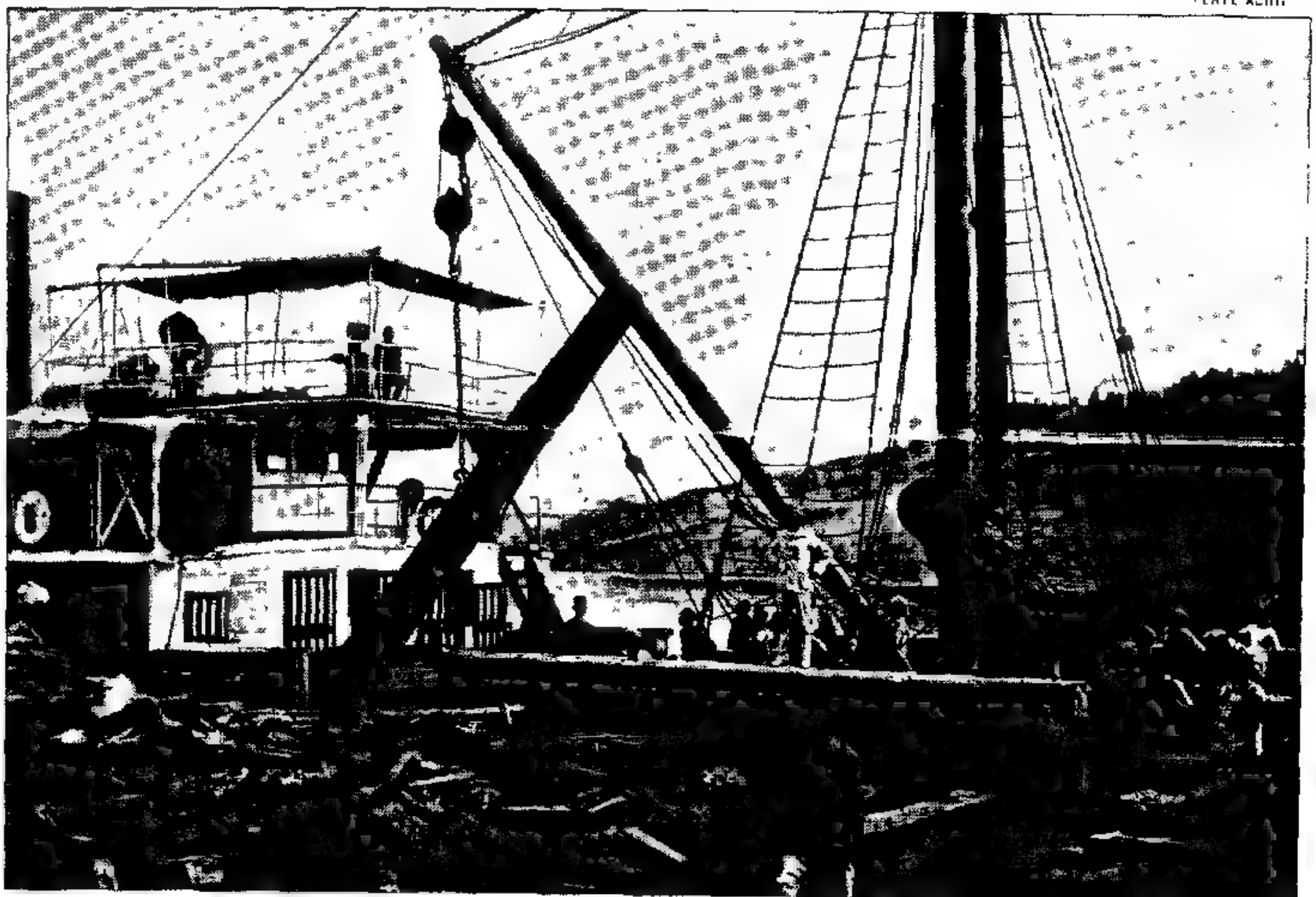


Photo. Mech. Dept., Thomason College Roorkee.

Photo by Mr Horeaam.

Unloading the Forest Department Twin Screw Timber Boat ROSAMUND in the Andaman Islands.

9. The Padauk forests of the North Andaman will in future be treated under the selection system, and the whole area will be worked over once in 15 years, *i.e.*, half the period it takes a Padauk tree of the lowest dimension of Class II (6½ feet in girth) to become Class I (7½ feet in girth)

During the first period of 15 years the minimum girth limit for felling will be 8 feet except in certain very dry localities [*vide* para. (3) above] where the minimum girth limit will be 7 feet.

Padauk natural regeneration is believed to be sufficiently good to ensure a steady yield if assisted by suitable fire-protecting measures and judiciously executed improvement fellings, and also by sowing or planting up the blanks caused by the fellings.

Although fairly satisfactory results have been obtained in the South Island, near Port Blair, by planting Padauk in areas that have been practically cleared of forest-growth for cultivation, the cost of clearing and tending such plantations is very high in proportion to the results obtained.

TIMBER WORK IN THE ANDAMANS.

BY F. TRAFFORD, I.F.S.

I enclose two photographs taken here which will give the readers of the *Indian Forester* some idea of the timber work undertaken departmentally in the Andamans. One of these depicts the unloading of the Forest Department twin screw timber boat "Rosamund" built by Mr. Bonig, the Extra Assistant Conservator of Forests. With the exception of the machinery and fittings this boat is built of local timber. The boilers are heated with wood fuel (the billets can be seen in the foreground). The logs for export are put on the truck, the rails running close to the side of the ship, and then arranged for measurement by the tusker elephant which, owing to sores, is unable to do dragging work. After measurement the logs are dropped into the sea and taken to the Calcutta Steamer. The second photograph shows an arrangement for stacking logs on dry

land in a limited space which works well; the idea may be useful to some of your readers. Logs cannot be kept in the sea for any length of time owing to the depredations of the teredo, which prefers hard woods to soft ones curiously enough.

The stacking arrangement consists of a differential pulley for hoisting (about two men per ton weight) slung on a frame supported on a single grooved wheel; this wheel runs on a rail fastened on to a jointed longitudinal beam which is carried on brackets attached to upright posts. The distance between the posts is 18 feet. The posts are 10" × 10" in section and the beam 13" × 6". The rail is about 18 feet from the ground but it has now been found better to have it 25 feet from the ground, which will allow of logs being stacked in six tiers instead of three.

I am indebted to Mr. Boreham, overseer, Ross Island, Port Blair, for the two photographs I send.

PORT BLAIR, ANDAMANS:

13th October 1906.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

AFRICAN BIG GAME.

PRESERVATION MEASURES.

As long ago as 1896 the "excessive destruction by travellers" of big game in Africa attracted the attention of the late Lord Salisbury, as Minister of Foreign Affairs, and caused him to write a despatch to Mr. A. Hardinge of the East Africa Protectorate, and Mr. Berkeley of Uganda, asking them to consider whether it would be advisable to deal with the question by establishing a close-time and specifying reserved districts, and by limiting the number of a particular class of game to be shot by an individual sportsman. In any case, Lord Salisbury suggested, those intending to shoot big game for sporting purposes should be made to take out a license, the fee for which should be high enough to serve as a check.

There has been a great deal of correspondence on the subject since then, and the whole of it is gathered together in a formidable Blue Book which has just been presented to Parliament. A proposal was mooted in 1897 that the export of tusks of less than five kilogrammes weight should be prohibited, and that thus all incentive to the killing of young animals should be withdrawn, and an international convention to this effect was signed in May 1900 by Great Britain, Germany, Spain, France, Italy, Portugal, and the Congo Free State. By the same convention a system of reserves was established, the destruction of females was to a certain extent prohibited, and other precautions were taken to avoid interference during the breeding season with those animals which it was desired to preserve.

At the conference which agreed to this convention a memorandum was submitted by Sir Harry Johnston on the future of the elephant. Ivory he pointed out was the chief export of British Central Africa, and the elephant was the most valuable animal in

the country from the commercial point of view. "I have given a good deal of consideration," he added, "to the question of whether the elephant is likely to become extinct, or whether it is possible *that a moderate trade in ivory and the continued existence of the* elephant are compatible. I have come to the conclusion that, provided the Brussels Act is enforced and guns and gunpowder kept from the natives, especially from the Arabs, and Europeans only are allowed to shoot elephants by taking out a license, the elephant is likely to exist with us for all time, and yet supply a sufficiency of ivory for the trade. The fact is we should leave the bulk of the elephant-killing to those natives who kill the elephant by trap and spear. They do not perpetrate anything like the same destruction as the natives armed with guns, who indiscriminately shoot every elephant they come across. On the contrary, the natives who use only the spear naturally select bull elephants with good ivory, as it is almost as dangerous to attack a cow with small tusks, or with none at all, as to attack the biggest bull elephant. For the same reason they do not kill the young elephants.

"*As regard traps and pitfalls, they do not* ensnare many beasts after all, and are generally so constructed that a young elephant might succeed in passing where a large and heavy beast would fall in. There are, further, certain marshy districts of vast extent, such as those which surround the south end of Lake Mweru, where the elephant would appear to have found a naturally guarded preserve —a refuge where only the white man would have the energy and resources to follow him. To these preserves, there is no doubt, the female elephant retires at the time when it is giving birth to its young. Consequently, if the white hunter is kept under control, and gunpowder is from the natives, there may be some chance of the elephant's existence being prolonged indefinitely. I think, however, some improvement in our existing regulations might be made in increasing their stringency, and making it almost a penal matter to shoot the cow elephant or the young elephant with tusks under certain weight and size, as the slaughter of these beasts is simply wanton destruction, for their commerical value bears no proportion to the risk and trouble involved in killing them."

There was some idea then that the elephant might be trained for commercial purposes, but that notion was eventually abandoned. Sir Harry Johnston observes on the question: "As to whether the African elephant could be tamed, it is a question on which I hesitate to pronounce an opinion. Not infrequently young elephants are caught and given to Europeans; but they invariably die, because it is not a country where the milk supply is abundant, and it is usually impossible to procure enough milk to rear young elephants. Even, however, if he were reared to maturity, I think the disposition of the African elephant is too capricious and *naturally savage to constitute him in any way a reliable beast of* burden."

Towards the hippopotamus Sir Harry Johnston has no kindly feelings. He declares him to be a greater pest than any mammal found in Africa.

"He is extremely dangerous in all the rivers to boats and canoes," says Sir Harry, in description of the animal's wickednesses, "and I can personally testify that he frequently attacks without the least excuse—that is to say, without any provocation having been offered him. He commits intolerable ravages amongst the natives' crops or on such European plantations as are near the river banks. As a commercial item, his tusks are moderately valuable and his hide very valuable. Although I would advocate the extermination of the hippopotamus, I know that in pronouncing this sentence it is much less easily accomplished than the extinction of the elephant, for there are many parts of the country where the hippopotamus, like the elephant, finds natural preserves into which it is almost impossible to follow him, and as the hippopotamus breeds at a quicker rate than the elephant he is able to keep pace with the attacks which are made on him.

Local settlers urge another objection to the preservation of big game besides the direct injury they do. The ravages of the tsetse fly among herds of cattle are a very serious matter in many parts of the African Continent, and some of the planters urge that these insects are harboured by the larger wild animals. In opposition to this view the Society for the Preservation of the Fauna of

the Empire has repeatedly urged on the Colonial Office that this statement should not be accepted till inquiry has been made as to whether there are not other means of destroying the tsetse fly than by the butchery of the wild animals, and that in any case it would be possible to discriminate between the different varieties of big game.

The signing of the International Convention by no means concluded the correspondence. Since then the Society for the Preservation of the Fauna of the Empire has pressed the Colonial Secretary for greater stringency in the enforcement of the regulations, and a deputation waited upon Lord Elgin in June of this year to that end, Lord Curzon of Kedleston being a principal speaker. About the same time a new ordinance was promulgated for Southern Rhodesia, embodying very elaborate regulations. In a final despatch Lord Elgin intimates to Commissioner Sir A. Sharpe, of the British Central Africa Protectorate, that he desires him to prohibit the sale of elephant tusks under 25 lbs. and to permit no shooting, except for administrative reasons, in a reserve. —*The Pioneer.*